22900108293

Digitized by the Internet Archive
in 2014

https://archive.org/details/b2040041x

9.B.N.

# THE

# PRINCIPLES AND PRACTICE

# OF

# OPERATIVE SURGERY.

BY

**FREDERIC C. SKEY, F.R.S.,**

Member of the Council and of the Court of Examiners of the Royal College of Surgeons of England;
Surgeon to St. Bartholomew's Hospital, and Professor of Anatomy to its Medical College;
Consulting Surgeon to the Great Northern Hospital; to the Charter-House;
and various other Institutions.

SECOND EDITION.

LONDON:
LONGMAN, BROWN, GREEN, AND LONGMANS.
1858.

18722

LONDON:
BRADBURY AND EVANS, PRINTERS, WHITEFRIARS.

WELLCOME INSTITUTE
LIBRARY
Coll. welMOmec
Call No. W0500
1858
S62r
M19478

# PREFACE TO THE FIRST EDITION.

The following work was undertaken in compliance with the advice of some professional friends, who equally felt with myself the want of a book on the subject of Operative Surgery, which might become, not simply a guide to the actual operation, and embrace the practical rules required to justify the appeal to the knife, but would embody, at the same time, such principles as should constitute a permanent guide to the practitioner of Operative Surgery, and without which, all claim to its scientific character is lost.

As in the pursuits of practical surgery, the knowledge of "principles" exceeds greatly in value that of the details of practice, because the principles form the rule of conduct, and the practice the deduction, so a knowledge of the principles of Operative Surgery, which ought to regulate the conduct of the surgeon in undertaking even the least critical forms of operation, is all important as the guide and load-star of our conduct. It is a consideration of far less moment, in what manner an operation be performed, provided it be executed with safety, than is the previous decision of its actual necessity. The question of appeal to the knife, involves the principle, its employment, the practice of Operative Surgery. In no department of professional duty are the rules of conduct so imperative as in that which proposes the removal of a portion of the body, or the exposure of its internal structure by instrumental agency, because the effect of local violence is always felt as a blow to the integrity of the frame, although the operation itself, thanks to a great modern discovery, may be rendered painless.

A work on Operative Surgery, which consists merely of mechanical rules for the performance of an amputation, for example, would leave the undertaking more than half unfinished, simply because the knowledge, which determines the necessity of the operation is far more valuable, and far more difficult of attainment, than that which is required to qualify a surgeon for its performance. The one qualification involves both the moral feeling and the intellect of the surgeon. The other more prominently demands the exercise of his physical functions.

I hope to see this essential department of medicine occupying its just position, a position neither too exalted nor too low, in the esteem of the profession. To elevate it from this rank by attaching to it a value beyond its absolute worth, is to carry ourselves back into the past; to depreciate its value, is to exhibit an ill-judged reliance on remedies notoriously incompetent to cure. The first extreme argues a low appreciation of the value of human life, by the indulgence in uncalled-for experimentalisation, and recklessness of human suffering; the second betrays an unpardonable ignorance of the resources of this important department of medicine, and would award to the possessor of the highest qualities of the operator, little beyond the dexterous manipulation of a mechanic. Each extreme argues ignorance of Nature, her power, and her laws.

The moral feeling of the operating surgeon is more involved in the establishment of a just reputation than the world at large imagines; at least, if it be required that both the design and the execution of an operation devolve on his single responsibility. A surgeon may be required to step in between life and death; to venture on a large and speculative operation as the only alternative to certain death; and under no condition is it more important that he protect the high name of his profession from the obloquy that so commonly attaches to failure, by extending to the case all the knowledge that can be acquired, by weighing the liabilities in his own scale, and by not yielding his judgment into the hands of those, who, less competent than himself to calculate the danger of the undertaking, and less responsible for the consequences of failure, would urge him on to resort to such means as prudence would justly repudiate.

These are the class of cases that test the moral tone, as well as the professional competency, of the surgeon, because success depends less on the power to manipulate than on the knowledge of the vital forces involved in the economy, and no less on his possession of judgment, and honor, and a spirit of independence, by which "he may the better judge;" attributes that should maintain him above such influence as would render him a mere instrument in the hands of others, less competent than himself to foretell the consequences of a rash appeal to an uncalled-for and dangerous agency. It may be urged, in furtherance of the proposition, that death is certain without it, and that an operation cannot add to the difficulties that already surround the case. But this argument, though plausible, should only be admitted on the fullest consideration of its applicability. It appears reasonable enough to propose an operation,—I might almost say, any operation,—as an alternative, when death is the only and the certain condition of its non-performance.

I would go as far as any man in the effort to restore a life jeopardised by disease, so long as the chance of benefit would more than balance the consequences of failure. But it must not be forgotten, that the interests of Operative Surgery invariably suffer from unsuccessful, and still more from fatal operations; that under the most promising condition, human nature shrinks from its appeal with fear and revulsion, and that failure in one case will probably deter many from submitting to operations which offer results far more encouraging. There is no eclat, no grandeur in a large surgical operation, but that which it derives from its success. The admiration of its performance, however well executed, is restricted to the limited circle witnessing it; the failure and consequent death of the victim becomes the property of rumour, with her hundred tongues, which proclaim to the credulous world, that a human life has been wantonly sacrificed to gratify a morbid passion for notoriety, not to attribute the result to a still less commendable motive.

The operating surgeon is not a mechanic, but the agent through whose instrumentality is carried into action the highest principles of scientific medicine, principles demanding an intimacy with the soundest physiology. He wields a power more grand, and more critical, and, at the same time, more terrible to humanity, than the member of any other branch of our profession. Compared to his authority and power, when engaged in his legitimate path, the pursuits of the physician appear both trivial and tedious. The occasional error of the physician is corrigible, that of the operator is fatal. Life and death hang suspended on his effort; health, recovery, deformity, and death are the issues of his hand.

There is no department of medical practice more attractive to the younger members of our profession than that of Operative Surgery. Its brilliancy, its eclat, its critical influence on disease, all contribute to this popularity, and attach an interest to it in the minds of the student of medicine, far beyond that connected with the study of any other department. The value of a hospital is too often appreciated by the number of its operations, not by the exhibition of the curative power of its surgical staff, and still less by the success which follows the frequent resort to the knife. The operating theatre is a place of weekly resort, the "high change" of the institution, at which we find united the largest assemblage of professors, of students, and their friends. Is not this enthusiasm somewhat misapplied? Between the claims to respect of Curative and Operative Surgery, there is no comparison. I venture to say, with all respect to my many superiors in surgical acquirement, that it is the duty of the teacher to expatiate with all the power of his authority on the superiority of the one over the other.

There is no greater obstacle to the advance of high classed surgery, than the man who, having acquired the reputation of a dexterous operator, regards the world as the great field of his experiments. A man who has the reputation of a "splendid operator" is ever a just object of suspicion; and I firmly believe that the bad operator, conscious of his weakness, will be found to have ever been the larger contributor to scientific surgical knowledge.

Two brief anecdotes will illustrate the principle. An eminent member of our profession is asserted to have said, "I have achieved my present rank by wading up to my knees in blood." Of another, and no less eminent man, it is said, that on being told by a medical friend that he had just witnessed a "beautiful operation," he looked at the observer with an eye of indignation, and replied, "Sir, I do not comprehend what a 'beautiful operation' means. I have never seen the operation to which the term beautiful could apply." Both these great men were at fault. At the period adverted to, doubtless, the value of human blood (although John Hunter had already established its vitality) was not appreciated, any more than were the remaining components of the body. The other authority must have acknowledged that perfection in any art is a source of the highest beauty. Both these sentiments are in extremes.

There is a position which Operative Surgery is entitled to hold in our esteem, and which, so long as it does not clash with, nor interrupt the studious and persevering effort of the surgeon to render its aid unnecessary, must ever rank among the most valuable departments of scientific medicine.

How far I have succeeded in accomplishing the task I have undertaken, and in fixing on its proper basis this really important branch of medical knowledge, in warning the surgeon from paths of danger and of difficulty, and of testing the question of every operation, *in foro conscientiæ,* before it is undertaken, I leave to the decision of others. I am old enough in my profession to have witnessed in past times much of wrong; I hope to live long enough to see this wrong converted into right. I have endeavoured, as an English metropolitan surgeon, to carry into execution at least one primary object, viz., to strip the science of Operative Surgery of a false glare, mistaken by the ignorant for the lustre of real excellence, to check a spirit of reckless experiment, and to repress rather than encourage the resort to the knife as a remedial agent. I do not pretend to have executed my task perfectly, or even to have reached the level of my own view of the necessities of the case. It may be charged against me that I have expressed freely, and perhaps more authoritatively than I am entitled, my own individual opinions, and have made little reference to those of others. In answer to this charge, I have only to remark, that I do not profess to give the multitudinous opinions of other men, and yet I have not withheld them. I have quoted the opinions entertained by most of the eminent members of the surgical profession, so far as a general intercourse and an extensive acquaintance have enabled me to command it. It has been the habit of my mind to lend but a hesitating obedience to the influence of authority unsupported by reason. A tolerably extensive intercourse with disease, has led to the opinions which I have embodied in the following work: I profess no more.

I must in candour, however, make an exception in behalf of the operations connected with ophthalmic surgery, in which my opportunities have been comparatively limited, and in this department I have not hesitated to make an extended reference to the works and opinion of others.

I am anxious to make my acknowledgments to my friend Mr. Savory, of St. Bartholomew's Hospital, who has lent me, throughout the work, his very valuable services, and of whose advice I have repeatedly availed myself. A season of probation is due to all members of our laborious profession; no amount of knowledge, no quantum of industry, no acquired accomplishment, can obtain a level path to fame, or give to youth the stamp and experience of age: Mr. Savory will bide his time; but I am greatly in error if he do not hereafter tread the highest paths of professional eminence.

# PREFACE TO THE SECOND EDITION.

In this, the second edition, I have endeavoured to correct the errors and to supply the deficiencies of the first.

Seven years have elapsed since the publication of this volume, and the period has not proved unproductive to the cause of sound practical surgery. Much ingenuity has been expended, and many and great improvements have been effected in the various details of different operations. I hope I have done justice to them in this edition. But it is in the principles rather than in the practice of Operative Surgery that the progress has been most conspicuous and satisfactory, and this is a far more important subject for congratulation. With the deepest interest I witness the advanced and still advancing spirit of conservatism. This word has been strangely misapplied. By conservatism I do not understand only the exercise of that ingenuity and dexterity which would substitute a less operation for a greater, but that infinitely higher surgery which aims at restoration rather than at substitution,—which truly regards the knife as a last resource, and its employment under any circumstances as a confession of ignorance. And commensurate with the extended recognition of this great principle have arisen, as the inevitable consequence, more enlightened views of the treatment of disease. Gradual, yet vast the change. The "heroic" method is fast following in the track of its many victims. Compare the frequency of venesection now with a few years since; or the use of drastic purgatives, mercury, tartarised antimony, and drugs of a similar class, on the one hand, with the employment of such remedies, on the other, as steel, quinine, and cod-liver oil, and, above all, the more liberal allowance of food and stimulants. I do not argue now whether this is more successful; it is enough for me to appeal to the change. Why has the "tonic" plan of treatment been of late years so much approved? What does it mean?* Surely this, that the more closely we scrutinise the phenomena of disease and study its lessons at the bedside and in the theatre by the light of physiology, the more plainly are we taught to rely upon Nature for repair and recovery, —the more distinctly are we warned not rashly to obstruct her by an impatient interference, or by exhausting her resources to frustrate her designs. We are taught to be more expectant; to watch her actions in order to assist them by husbanding the forces with which she works.

In this edition I have omitted the section on the Operative Surgery of the eye which appeared in the last. This subject has now become so special, and so much has lately been done in it, that, in the absence of any great personal experience, I gladly refer the reader to the admirable works we possess. The same remarks will apply to the surgery of the ear.

Finally, let me add, that I am painfully sensible that this work falls far, very far, short of what I would wish it to be. I fear it will require no great amount of critical acumen to discover its faults. Yet I venture to hope that while no important points of detail have been omitted, I have not been altogether unsuccessful in that which is more especially my purpose—the enunciation of sound principles.

---

* Is it to be explained by a corresponding change in the type of disease? It is a fact worthy of observation, that those who advance this not very intelligible plea are the most reluctant to admit any change into their practice.

# INDEX.

Page

ABDOMINAL PARIETES: operations on . . . . . 559
  Paracentesis abdominis—ovarian dropsy . . . 559
  Puncture of intestine in constipation . . . . 677
ABSCESS: progress and treatment of . . . . . . 73
  in bone . . . . . 487
  Abdominal . . . . . 561
  Pelvic . . . . . 563
  Perineal . . . . . 625
ACUPUNCTURE . . . . . 699
  as a curative agent . . . . 700
  employed for exploration . 700
    case . . . . . . 700
  Drilling . . . . . 701
ADHESIVE PLASTER . . . . 57
  Mode of applying . . 64, *et seq.*
Adipose tumours . . . . 498
AIR: admission into veins . 719
  cause of death doubtful . . 720
  Post-mortem appearances . 722
AMPUTATION . . . . . 337
  Operations of expediency 22, 340
  Warrant for . 340, *et seq.*
    in compound fracture . . 345
  Cases for immediate . . 347
  Erroneous views of reaction . 347
  Less danger of, when remote from centre . . . . . 349
  Circular incision . . . . 350
  Flap operation . . . . 352
    advantages of—demerits . 355
    flap of the integuments only . . 353—356
    grounds of selection . . 353
    future services of stump . 354
    composition of stump . 354
    sugar-loaf stump . . . 354

Page

AMPUTATION (*continued*).
    Tourniquet, common, bad in principle . . . . 359
    Italian . . . . . 360
    Improved . . . . 360
      advantages of . . 361
  at shoulder-joint . . . 362
    pressure on subclavian artery . . . . . 363
    flap of the deltoid . . 364
    double flap . . . . 365
    dressing the wound . . 366
  Humerus, immediately below head . . . . . 367
    advantages of . . . 367
    double flap . . . 367
    circular operation . . . 367
  Humerus, at middle of arm . 368
    circular operation preferable 368
  at elbow-joint . . . 369
    anterior flap . . . 370
  Forearm, below elbow-joint . 371
    double flap . . . . 371
    form of incision . . 372
  Forearm, lower third . . 373
  Hand, at wrist-joint . . 373
    retaining carpal bones . . 374
    carpo-metacarpal joint . 374
    retaining the thumb . . 376
  Removal of the thumb . . 376
  Little finger, at carpal-joint . 378
  Removal of second or third fingers . . . . 379
  Removal of fingers at their joints . . . . 380
    various methods . . . 380
  Hip-joint . . . . . 381
    double flap . . . . 383
    circular . . . . 383
    below trochanter . . . 384

Page
Amputation (*continued*).
Lisfranc's operation . . 386
Guthrie's operation . . 387
flap of the integuments and circular incision of the muscles . . . . 388
below trochanter minor . 390
Thigh . . . . . 390
length to be retained . 391
varieties of operation . . 391
by single division of soft structures . . . 394
Leg . . . . . 395
position in life determines the place of division . 395
middle of the calf . . 396
circular . . . . 396
double flap, at calf . . 397
improved operation . . 398
above ancle-joint . . . 399
Foot, at ancle-joint . . 400
Mr. Syme's operation . . 400
Pirogoff's operation . . 401
across middle of tarsus, or Chopart's operation . 402
across tarso-metatarsal articulation—Hey's operation 405
Great toe, with metatarsal bone 407
Little toe . . . . 408
Great toe . . . . 408
Penis . . . . . 409
Anchylosis, false: treatment by laceration . . . 455
Ancle-joint: excision of . . 447
Moreau—Sir A. Cooper . . 448
Subcutaneous divisions . . 448
Astragalus left intact . . 449
Operation . . . . 450
Aneurism . . . . . 219
Nature of—and varieties . 219
Classification . . . . 221
Contents of the sac . . 222
Symptoms of, analysed . . 224
Examples of false diagnosis . 225
Spontaneous cure of . . . 226
processes of, various . . 227
Principle of treatment . . 227
Mortality from treatment by ligature . . . . . 228
Treatment by compression . 229
Mode of applying compression 231
tourniquet . . . . 232
Treatment by ligature . . 233

Page
Aneurism (*continued*).
Grounds determining the selection . . . . . . 234
Operation . . . . . 234
oblique incision over arteries 234
Extreme tension of ligature unnecessary . . . . 237
Separation of ligature, period of 237
Brasdor's operation . . . 238
Immediate consequences of the operation . . . 239
Treatment by manipulation—Mr. Fergusson . . . 241
Varicose . . . . . 271
Hunterian operation inapplicable . . . . 273
operation for . . . 274
operation at the sac . . 275
Aneurismal varix . . . 271
Anus: imperforate . . . 682
Nature of defect . . . 683
Operation . . . . 683
After-treatment . . . 685
Operations around . . 623
Aorta: Abdominal . . . 290
Anatomy of . . . 290
Sir A. Cooper's operation for tying . . . . . 290
Mr. James's . . . 291
Arteria innominata . . . 248
Anatomy of—diagnosis . . 248
Operations for tying . . 250
Arteries: operations on wounded 201
Structure of . . . . 201
Extent of bleeding — how qualified . . . . 202
Ligatures applied under three conditions . . . 202
Traumatic hæmorrhage . . 203
Four natural means of arresting hæmorrhage . . 204
Surgical means . . . 204
Mr. Webber's torsion forceps. (*See* Appendix.)
Ligatures on arteries, effects of 205
Coagulum, questionable value of . . . . . . 206
Wounds of . . . . 207
Evidence of wound of a large vessel . . . . 207
Operation to be selected . 209
Exposed branches to be included . . . . 210

Page

ARTERIES (*continued*).
- Vein wounded . . . 211
- Ligature on vein harmless . 211
- Hæmorrhage from small vessels . . . . . 212
- Cases of wounded arteries . 212
- Efficacy of exposing bleeding surface . . . . 214
  - cases illustrative . . 215
- On tying of arteries in wounds and amputations . . . 243
- Medullary artery . . . 245
- Subclavian, anatomy of . 253
  - aneurism in the 3rd stage 254
  - Mr. Colles' case . . 254
  - division of scalenus anticus 255
  - Mr. Ramsden's case . . 255
  - operation for tying in 3rd stage . . . . 256
  - operation adopted by myself in the case of the Rev. Mr. —— . . . 258
  - advantages of . . . 258
  - case of Mr. —— . . 259
  - chronic phlebitis . . . 262
  - nerve liable to be tied . 263
- Axillary, anatomy of . . 264
  - aneurism, symptoms of . 265
  - difficulty of operation below clavicle . . . 266
  - operation in 3rd stage . . 267
- Brachial, anatomy of . . 269
  - irregularity of its relations 269
  - traumatic aneurism of . . 270
  - aneurismal varix . . 271
  - varicose aneurism . . 271
  - Hunterian operation inapplicable . . . . 273
  - operation for . . . 274
  - operation at the sac . . 275
- Radial, anatomy of . . . 277
- Ulnar, anatomy of . . 278
  - wounds of arteries of the hand . . . . 278
  - operation on radial . . 279
  - operation on ulnar . . 279
- Common Carotid, anatomy of 280
  - diseases resembling aneurism of . . . . 282
  - symptoms of aneurism of . 283
  - operation . . . 283
  - Brasdor's operation . . 284
  - lower operation . . 284

Page

ARTERIES (*continued*).
  - upper operation . . . 285
- Superior thyroid . . . 286
  - operation . . . . 286
- Lingual . . . . 287
  - operation . . . . 287
- Facial . . . . 288
  - operation . . . . 288
- Occipital . . . . 288
  - operation . . . . 288
- Temporal . . . . 289
  - operation . . . . 289
- Abdominal aorta . . . 290
  - anatomy . . . . 290
  - Sir A. Cooper's operation . 290
  - Mr. James's . . . 291
- Common Iliac . . . 292
  - anatomy of . . . . 292
  - first tied by Dr. Mott . . 293
  - Mr. Stanley's case . . 293
  - posterior operation preferable . . . . 294
- Internal Iliac . . . 295
  - anatomy of . . . . 295
  - operation adopted by Mr. Stevens . . . 295
  - posterior operation objectionable . . . . 296
- External Iliac . . . 298
  - anatomy of . . . 298
  - Mr. Abernethy's operation 300
  - Mr. Freer's operation . 301
  - Sir A. Cooper's operation . 303
  - Mr. Norman's operation . 303
  - conditions determining one or other operation . 303
- Femoral . . . . 304
  - anatomy of . . . 304
  - operation . . . . 306
  - cases . . . . 308
  - operation in Hunter's canal 309
- Popliteal . . . . 310
  - anatomy of . . . 310
  - operation . . . . 310
- Anterior tibial . . . 312
  - operation . . . . 313
- Posterior tibial . . . 314
  - anatomy of . . . . 314
  - operation on inner margin of tibia . . . 315
    - through calf . . . 315
  - relative merits of two operations . . . 317

Page
Arteries (*continued*).
operation on lower third . 318
behind inner ancle . . 319
Peroneal . . . . . 319
anatomy of . . . 319
operation . . . . 320
Dorsal, of the foot . . . 320
External plantar . . . 321
Arteriotomy . . . . 331
Ascites . . . . . . 560
Case of puncture through scrotum . . . . 560
Assistants, Duty of . . . 8
Astragalus: Dislocation . . 145
Symptoms — mode of reduction . . . . 145
Autoplastic operations . . 686
(*See* Cicatrices.) . . . 686
Perineum ruptured . . 691
operation . . . . 692
Fistulæ recto-vesical and vaginal . . . . 693
favourable and unfavourable cases . . . 694
operations . . . 694
Axillary artery. (*See* Artery.) 264

Bandages:
The T bandage . . . 154
Four-tailed . . . . 154
Many-tailed . . . 155
Starched . . . . 173
Bending of young bone . . 173
Bistoury . . . . . 33
Bladder: Puncture of . . 635
Through perineum . . . 635
abdominal parietes . . 636
rectum . . . . 637
Bleeding from wounds . . 54
Oozing of blood in, methods of arresting . . . 54
Extent of, how qualified . . 202
Ligatures applied under three conditions . . . 202
Traumatic hæmorrhage . 203
Four natural means of arresting . . . . 204
Surgical means . . . 204
Webber's torsion forceps. (*See* Appendix.)
Ligature on artery, effect of . 205
Coagulum, questionable value of 206

Page
Bleeding (*continued*).
Evidence of wound of a large vessel . . . . 207
Operation to be selected . . 209
Exposed branches to be included . . . . 210
Vein wounded . . . 211
Ligature on vein harmless . 211
Hæmorrhage from small vessels . . . . 212
Cases of wounded arteries . 212
Efficacy of exposing bleeding surface . . . 214
cases illustrative . . . 215
Blunt-edged knives . . . 45
Bone—necrosis . . . . 486
Abscess in . . . . 487
forceps . . . . . 37
Bougie: On the employment of . 615
Brachial artery: Anatomy of . . . . . 269
Irregularity of its relations . 269
Traumatic aneurism of (*See* Artery.) . . . . 270
Brasdor's operation . . 239, 284
Breast, Tumours of . . . 504
Bronchocele . . . 504, 545
Treatment by tying superior thyroid artery . . 545
often hysterical . . . 546
case . . . . . 546
Thyroid cells . . . 546
Puncture . . . . 547
Seton-thread . . . 547
Bullets: Course of . . . 697
Incisions, when to be resorted to . . . . . 697
case . . . . . 698
Burns: Effects of. (*See* Cicatrices.) . . . 686
Bursæ, and Ganglions . . . 512
Natural and adventitious . 512
Treatment usually adopted . 514
by seton-thread . . 514
burrowing under carpal ligament . . . . 516
treatment by incision . 517
Butcher's-saw, so called . . 731

Cæsarean operation . . 702
Question of embryotomy . . 703
Statistics of Dr. Kayser . 703

Page
CÆSAREAN OPERATION (*continued*).
  Degree of contraction of pelvis 704
  Question of operation before 9th month . . . 705
    case 1st . . . . 705
      operation . . . . 709
      after-treatment . . 713
    case 2nd . . . . 713
CANCER, EPITHELIAL . . 501
  scroti . . . . . . 502
Carcinoma—hard—diffused (*see* Tumours) . . . 509
Caries . . . . . . 487
Carpus, Dislocation of . . 120
CASTRATION . . . . . 610
  operation . . . . . 610
CATHETER : Introduction of . 611
  Natural course of urethra . 613
CATHETERISM in false openings . 617
  in enlarged prostrate . . 621
Chain trocar . . . . . 553
Charcoal—in fœtor . . . 72
CHEST, Operations on—paracentesis thoracis . . 556
  Responsibility of operator—Thompson's trocar . . 16
Chloroform operation . . 557
CICATRICES : Removal of . . 686
  Taliacotian principle often unsuccessful . . . 687
  New principle of treatment . 688
  Evils of slow cicatrisation avoided . . . . 688
  Incisions small and numerous 688
    arguments in favour of . 689
  Cases—after treatment . . 690
CLAVICLE. (*See* Dislocations.) . 92
    fractures . . . . . 175
Coagulum in wounds fatal to union . . . . 55
Compound fracture . . . 168
Compression in aneurism . . 229
Constipation, consequent on loss of blood . . . . 27
Cradle-fracture . . . . 195
CRANIUM : Operation for depressed bone . . . 518
  Symptoms of compressed brain . . . . 518
  Operation of the trephine . 519
Crepitus, Varieties of . . . 162
CURVATURE, Lateral, of spine . 461
  Remote causes . . . . 462

Page
CURVATURE (*continued*).
  Treatment of—1st stage . 466
    2nd stage . . . 469
  Operation rarely required . 471

DECOCTIONS of meat, Value of . 26
Depletion, Value of . . . 21
DIRECTOR, Common . . . 34
  Flat direction . . . 35
DISLOCATIONS . . . . 78
  Nomenclature of, bad . . 78
  Principles of reduction . . 79
  Muscular action the direct agent . . . . 82
    protracted cases . . . 83
  Date of reduction unlimited . 83
  Supposed causes of difficulty . 84
  Pullies, force of—note . . 87
  Lower jaw . . . . 89
    symptoms and mode of reduction . . . 90
  Clavicle, sternal end of . . 92
    symptoms and mode of reduction . . . 93
  Scapula, acromion process of . 94
    symptoms and mode of reduction . . . 94
  Humerus . . . . . 94
    cause of great liability . 96
    varieties . . . . 96
    causes of dislocation of . 97
      symptoms of . . . 100
    principle and mode of reduction . . . 103
      heel in the axilla . . 104
      knee in the axilla . . 104
    pullies applied on the principle of the heel in the axilla . . . . 106
    scapula should not be fixed 106
    extension upwards . . 108
  Elbow-joint, Structure of . 109
    radius and ulna backwards 111
      symptoms and mode of reduction . . . 112
    fracture of coronoid process 114
      treatment of . . . 117
    lateral dislocation outwards 115
      symptoms . . . 115
    lateral dislocation inwards 115
    radius forwards . . . 115
      backwards . . . 115

Page

DISLOCATIONS (*continued*).
  extension the general mode of reduction . . . 116
  fractured olecranon . . 117
  complicated dislocation with fracture . . . 118
  radius and hand from the ulna . . . . 119
    symptoms and mode of reduction . . . 119
  carpus and hand from the radius and ulna . . 120
    symptoms and mode of reduction . . . 120
 Thumb—symptoms and mode of reduction . . 122
 Femur—structure of joint . 124
  great varieties of dislocation . . . . 125
   cause of dislocation . . 127
  dorsum ilii, dislocation on . 128
   symptoms of . . . 128
  ischiatic notch, dislocation in 129
  dorsum acetabuli, dislocation on . . . 129
   symptoms of . . . 129
  obturator or thyroid foramen 129
   symptoms . . . 130
  os pubis, dislocation on . 131
   symptoms—varieties . 131
 Tuber ischii, dislocation on (note) . . . 131
  principle and mode of reduction . . . 131
  application and direction of extending force in each variety . . . 132
 Knee-joint . . . . 135
  patella . . . . 135
  simple—reversed . . 135
   symptoms and mode of reduction . . . 136
 Tibia . . . . . 137
  varieties, symptoms, &c. . 138
 Semilunar cartilage . . . 139
 Foot, at ancle-joint . . 139
  varieties . . . . 139
  principle and mode of reduction . . . 143
  Pott's dislocation . . . 145
 Astragalus . . . . 145
   symptoms and mode of reduction . . . 145

Page

DISLOCATIONS (*continued*).
 Nasal cartilages . . . 147
   symptoms and treatment . 148
 with fracture . . . 148
   treatment . . . . 148
   separation of epiphyses . 150
   dressing of wounds. (*See* Wounds.) . . 56, *et seq.*

ECRASEUR . . . . . 43
Elbow-joint, structure of, &c. . 109
Elevator . . . . 37
Empyema and hydro-thorax, Operation for . . . 556
Encysted tumours. (*See* Tumours.) 497
Epiphyses, separation of . . 150
Epistaxis, plugging the nose in . 528
Epulis . . . . . 534
Erectile tumours. (*See* Nævi Materni.) . . . 322
EXCISIONS, or resections . . 410
 Preliminary remarks . . 410
 of lower jaw . . . 413
   diseases warranting it . . 413
 of upper jaw . . . 416
   operation . . . . 417
 of scapula . . . . 419
   operation . . . . 420
 of joints . . . . 421
   sketch of history . . . 421
   principle involved . . 422
   objects to be attained . . 423
   removal of cartilage . . 425
   motion to be retained . . 426
 of shoulder-joint . . . 427
   evidence of disease . . 427
   operations . . . 429
   double flap of the deltoid by White of Manchester . 429
   single flap by Stromeyer . 430
 of elbow-joint . . . 431
   evidence of disease . . 432
   operations . . . 434
   Mr. Syme's operation . . 434
   M. Langenbeck's operation 435
   modified by Mr. Liston . 435
 of wrist-joint . . . . 437
   objections . . . 437
   operations . . . . 437
   Mr. Butcher's operation . 438
   Mr. Jones's operation . . 439
 of hip-joint . . . . 439

Page
Excisions (*continued*).
evidence of disease 439
operations 440
of knee-joint 441
statistics 441
success attendant on the cases of Mr. Jones 442
to what cause attributed 442
history, sketch of 442
operations 444
operation by H incision 444
operation by flap incision 444
patella removed by Mr. Fergusson 446
patella retained by Mr. Jones 446
division of hamstring muscles by Mr. Hutchinson 447
of ancle-joint 447
Moreau—Sir A. Cooper 448
subcutaneous divisions 448
astragalus left intact 449
operation 450
of finger-joints 451
operation 451
Comments on operation of 452
Treatment of false anchylosis by laceration 455
pathology of 456
method of operating 456
Expediency, Operations of 22, 340
Extraction of foreign bodies 696
Extravasation of urine 624

False openings mistaken for stricture 619
Cases 619
Catheterism in enlarged prostate 621
Symptoms of 621
Mode of overcoming obstruction 622
Femur: structure of joint 124
Dislocation of. (*See* Dislocation.) 125
Fingers: Contracted 485
Webbed 485
Fistula in ano 642
in perineo 639
Contracted urethra 640
Treatment 640
Fistulæ: recto-vesical and vaginal 693

Page
Fistulæ (*continued*).
Favourable and unfavourable cases 694
Operation 694
Foot: Dislocation of. (*See* Dislocation.) 139
Paralysis of elevators of 478
Artificial elevation of 479
mode of effecting 479
Loss of arched form of 481
cause unexplained 483
treatment 482
Forceps, varieties of 35
Fractures 157
Simple—Compound, definition of 158
Overlapping — Retraction of muscles 160
Crepitus, varieties of 162
Oblique, symptoms—evils of 163
Two indications — reduction and retention 164
Splints, number of, &c. 164
Pads, construction of 164
Extension and counter-extension 165
Permanent extension 167
Contused limb 168
Extent of injury justifying amputation 169
Protruded bone—treatment of 170
Interrupted splint 171
Fracture-bed 171
Constitutional treatment 171
Into joints 172
With dislocation 173
starched bandage 173
partial or green-stick frac- 174
ture 174
of lower jaw 174
of ribs 175
of clavicle 175
symptoms 176
of scapula 176
coracoid process 177
neck, partial or complete 177
of humerus 178
below insertion of deltoid 179
of neck 179
treatment, &c. 180
above condyles 181
resembles dislocation 181
treatment 181
of forearm 182

Page
Fractures (*continued*).
above styloid processes . . 182
of pelvis . . . . . 184
varieties of fracture . . 184
treatment . . . . 185
of thigh bone . . . . 185
of the neck . . . 185
symptoms . . . . 186
Cases of inversion of the foot . 186
Rare cases without symptoms 187
Elevation of upper end in fracture below trochanter minor 188
Splitting of the shaft . . 188
treatment . . . . 189
of Patella . . . . . 191
varieties—treatment . . 192
M. Malgaigne's instrument 194
of Leg . . . . . 194
Variety of positions . . 195
Fracture-cradle . . 195

Galvanic Cautery—Mr. Marshall . . . . . . 642
Ganglions . . . . . . 515
Treatment by puncture, &c. . 515
Gangrene of intestine in hernia . 587
Gelatiniform polypus nasi . . 526
Glands, Enlarged cervical . . 500

Hæmorrhage . . . . . 24
Hæmorrhoids . . . . . 641
Excision—ligature . . 641
Galvanic cautery . . . 642
Nitric acid . . . . 642
Hare-lip: varieties . . 530
Age—operation . . . 531
Hematocele . . . . . 608
Symptoms—treatment . . 608
complicated with hernia . 609
Hernia . . . . . . 567
Introductory remarks . . 567
Remote causes . . . 567
Symptoms of strangulated . 570
Exploration of doubtful cases . 571
the taxis . . . . 573
Remedies prior to operation . 574
Operation . . . . 575
Question of division of the sac 576
Arguments favouring division 576
against division . . 577

Page
Hernia (*continued*).
Inguinal . . . . . 578
anatomy of . . . . 578
Ventro inguinal, or direct . 579
Congenital . . . . . 570
operation without division of sac . . . . 581
with division of sac . 581
Cœcal . . . . . . 585
strangulated in the canal . . 586
splitting of the cord . . 586
discoloured intestine . . 587
gangrene of . . . 587
treatment of . . . 588
wound of intestine . 588
after-treatment . . 589
Signs of true inflammation 590
of false . . . 591
treatment . . . 591
Femoral . . . . . 592
Anatomy of . . . . 592
Obturator artery . . 593
case of division of . . 593
Operation for . . . 594
Division of Gimbernat's, with a blunt knife . . . 595
Umbilical . . . . . 595
Saccili . . . . 596
operation for . . . 596
after-treatment of hernia . 597
radical cure of hernia . 599
Wurtzer's operation . . 600
Hydrocele . . . . . 605
Chronic hydrocele . . . 605
treatment . . . 605
Injections—port wine, iodine, &c. . . . . . 606
of the spermatic cord, or encysted hydrocele, male and female . . . 607
Nature of treatment . . 607
Hydro-hematocele . . . 610
Hydro-thorax, operation for . 556

Incisions: length and direction of . . . . . 50
Index to instruments required for each operation . . 733
Intestine: puncture of, in constipation . . . . 677
Symptoms of intestinal stricture . . . . 677

Page
INTESTINE (*continued*).
  Motives justifying interference . . . . 679
  Lumbar operation . . 681
  Anterior operation . . 681

KNEE-JOINT: Dislocations at . 135
Knife, Use of . . . . . 28
  Positions of . . . . . 29
  Varieties . . . . . 32

LACERATION in anchylosis . . . 455
Laryngotomy . . . . . 555
Leg, fractures of . . . 194
Ligatures . . . . . 47
LITHOTOMY AND LITHOTRITY . 644
  Symptoms of stone . . . 645
  Factitions signs . . . 645
  On the use of the sound . . 647
  Qualities of stone often ascertainable . . . 648
  Encysted stone . . . 649
  Conditions essential for lithotrity . . . . 651
  Composition of the stone . 653
  Circumstances contra-indicating lithotrity . . . 655
  Operation of lithotrity . . 657
  Method of expanding the lithotrite when in the bladder 658
  Rule for readily seizing the stone . . . . 658
  Last fragments . . . 659
  After difficulties, mode of obviating them . . 659
LITHOTOMY, on . . . . 662
  Office of the staff . . . 663
  Mode of holding . . . 665
  Knife—gorget . . . 665
  Forceps . . . . 666
  Structures usually divided . 668
  Operation . . . . . 670
    after-treatment . . 675

MANIPULATION, rough, objectionable . . . *passim*
Microscope, Value of . . . 494

Page
NÆVI MATERNI, and erectile tumours . . . . 322
  Definition of . . . 322
  Varieties . . . . 322
  Treatment . . . . 323
    by vaccination . . . 323
      nitric acid . . . 323
      potassa fusa . . . 324
      setons . . . 324
      extirpation . . . 325
      ligatures round the base 325
      injections—perchloride of iron . . . . 325
NECROSIS . . . . . 486
  Cases . . . . 486
  Operation . . . . 489
NEEDLE . . . . . 40
  Grooved . . . . . 40
  Open . . . . . 42
  Sewing . . . . . 42
Nervous symptoms . . . 23
Nose: plugging in epistaxis . . 528
  Operation . . . . 528

OOZING of blood . . . 54
Ovarian dropsy . . . 559
OVARIOTOMY . . . . 713
  Accurate diagnosis necessary 713
  Varying contents in multilocular cysts . . . 714
    operation . . . 717

PARAOENTESIS ABDOMINIS . . 559
  thoracis . . . . 556
Paraphymosis: treatment . . 604
PATELLA. (*See* Fractures.) . 192
  Dislocations of . . . 135
PELVIO ABSCESS . . . 563
  may burst into the bladder . 564
  may burst into the vagina or rectum . . . 564
  symptoms—puncture . . 565
Pelvis: Fracture of . . . 184
Penis: Amputation of . . 409
PERINEUM: Operations on male 623
  Abscess, puncture of 623, 625
  Extravasation of urine . 624
    free incisions . . . 625
  Operation in cases of stricture . . . . 626

Page
Perineum (*continued*).
thickening around urethra 626
Mr. Syme's operation . . 627
dvision of urethra . . 628
occasional false, may be due to false passages . . 630
cases . . . 630
Ruptured urethra . . . 632
cause of retention of urine 633
operation . . . 633
Ruptured, in parturition . 691
operation, autoplastic . 692
Phlebitis . . . . . 725
Chronic . . . . . 262
Phymosis . . . . . . 602
Structure of prepuce . . 602
Common operation . . . 603
Improved operation . . 603
Plaster, adhesive . 57, 64, 357
Polypus nasi . . . 526
Gelatiniform . . . . . 526
Fleshy . . . . . 526
Extraction by forceps . . 527
loop of wire . . . 527
silk worm gut . . . 527
Pott's dislocation . . . 145
Poultices . . . . . . 71
Pressure, Efficacy of . . 57
Probe . . . . . . 37
Prostate enlarged . . . 621
Protracted operations, evils of . 23
Pullies, force of,—note . . 87
Puncture of intestine in constipation . . . . . . 677
Pyemia . . . . . . 725

Ranula : nature of . . . . 532
Treatment by seton thread . 533
cases . . . . . . 533
Refracture of bones . . 196
Conditions justifying . . 197
Mode of effecting . . . 199
Resections. (*See* Excisions.) . 410
Responsibility of operator . 10
Rhinoplastic operation . . 520
Structure of nose . . 521
Flap from forehead . . . 522
operation . . . 522
Two lateral flaps . . . 525
Ribs : Fracture of . . . 175

Page
Saw . . . . . . . 36
Hey's . . . . . . 518
Spine, lateral curvature of . . 461
Splints . . . . . . 164
Sponge . . . . . . 48
Staphyloraphy, or operation for cleft palate . . . 535
Anatomy and functions of soft palate . . . . 536
operation . . . 538
Lateral incisions—M. Dieffenbach . . . . . . 540
Mr. Fergusson—division of levator palati . . . 542
After-management . . . 543
Functions of the tongue . 543
Actions of soft palate in speech 543
Exercises requisite . . . 544
Stricture : Pathology of . . 614
Instruments . . . . 615
On the employment of a bougie 615
Mr. Stafford's stilette . . 617
Mr. Fergusson's . . . 617
Mr. T. Wakley's dilators . 617
False openings, mistaken for stricture . . . . 619
cases . . . . 619
Sutures : Varieties . . . 59
Quilled . . . . 60
Uninterrupted . . . 61
Interrupted . . . . 61
Glover's . . . . . . 61
Twisted . . . . 61
Shotted . . . . . 62
Applied on the face . 63, 67
Supposed evil effects of . . 70

Talipes, or club foot . . 473
Nature and causes . . . 473
Varieties . . . . 474
Union of tendons . . . 475
Operation . . . . 477
After-treatment . . . 478
Tetanus . . . . 75
Tonsils : Enlarged, removal of . 534
Condition justifying operation 534
Guillotine—knife . . . 535
Tourniquet . . . . 359
Tracheotomy . . . . 548
Diseases requiring . . 548
Symptoms, urgent . . . 549

Page
Tracheotomy (*continued*).
  Operation above thyroid isthmus . . . . . 551
  Chain trocar . . . . . 553
  Operation below thyroid isthmus . . . . . 554
  Laryngotomy . . . . . 554
Treatment, preparatory . . 20
    subsequent . . . . . 25
    constitutional . . . . 25
    local . . . . . . 25
  Principles of treatment after operations . . . . 722
  Consequences of a large operation on the circulating and nervous systems . . . 722
  Exhaustion . . . . . 723
  Phlebitis—pyemia . . . 725
  New blood after hæmorrhage . 726
  Quietude after shock . . 726
  Stimulants indispensable . 726
  Salines and diaphoretics . . 728
  Low fever . . . . . 728
Trephine . . . . . . 519
Trocar: Minute . . . . 40
  Flat, in empyema . . . 557
  Curved, chain in pelvic abscess 566
Tumours: definition . . 492
  Benign and malignant . . 492
    signs of malignancy . . 493
    value of the microscope . 494
    degrees of malignancy . . 496
  Encysted . . . . . 497
  Adipose . . . . . . 498
    cases . . . 498
  Operation for removal . . 500
  Of the neck . . 500
  Malignant . . . . . 503
    progress . . 503

Page
Tumours (*continued*).
  Of the breast . . . . 504
  Conditions demanding removal 505
    justifying operation . . 507
  Escharotic treatment . . 504
  Operation . . . . . 507
  After-treatment . . . 508
  Hard carcinoma . . . 509
  Diffused carcinoma . . . 509
  Cases for rejection . . 509
  Removal of entire gland . . 510
    operation . . . 510

Urethra. (*See* Perineum.) . 623
  Ruptured . . . . 632
  Cause of retention of urine in 633
    operation . . . . 633

Varicose aneurism . . 271
  Veins . . . . . . 333
  Pathology . . . . 333
  Treatment by pressure . . 333
    by ligature . . . . 334
    by minute eschars . . 334
Varix, aneurismal . . . 271
Venæsection . . . . . 327
  Thrombus . . . . . 329

Wens . . . . . . 497
Wounds: Bleeding from . . 54
  Coagulum fatal to union . 55
  Union by direct or primary adhesion . . . . 66
  Lacerated, treatment of . 66

# OPERATIVE SURGERY.

## CHAPTER I.

INDISPENSABILITY OF OPERATIVE SURGERY AS A BRANCH OF MEDICINE — REQUISITES FOR PRE-EMINENT RANK IN OPERATIVE SURGERY — INDISPENSABILITY OF ANATOMICAL KNOWLEDGE — DUTY OF ASSISTANTS—MORAL RELATION OF THE SURGEON TO THE PATIENT —INDIVIDUAL RESPONSIBILITY OF THE OPERATOR—ARRANGEMENTS OF THE OPERATING ROOM—DUTY TO PATIENTS—CONDUCT IN THE CASES OF CHILDREN — CHLOROFORM — EXCEPTIONS TO ITS USE — TREATMENT PREPARATORY TO OPERATIONS—OPERATIONS OF EXPEDIENCY—AFTER TREATMENT.

Is operative surgery the opprobrium of medicine?

It has been often asserted, with some show of truth, that operative surgery is the confession of ignorance and the opprobrium of medicine; but it is not really so. When an operation is resorted to for the purpose of removing from the body a part diseased, which the skill or the patience of another man would have cured by the hand of nature, then alone does an operation become opprobrious. So long as man is the subject of accidents, by which his limbs are lacerated, or otherwise violently disorganized—of tumours, whose increasing size and relations are injurious to the growth, or to the free actions of the trunk or limbs—of deformities, or indeed of many other diseases, so long, probably, will the knife be resorted to, as our legitimate and only resource, against a greater evil. The knife should be essentially conservative in its operation; not to be employed as a shield to ignorance, or the stepping-stone to notoriety, but solely as the compulsory alternative to an evil of greater magnitude. In the profession of a surgeon the employment of the knife is the most striking, though not the most useful feature, distinguishing it not only from the other professions, but from the other branches of his own.

A too common incentive to the performance even of a necessary operation, is derived from the *éclat* attendant on its successful termination. This *éclat,* this love of notoriety, inseparably interwoven with human character, has a tendency to distort the judgment, and to weaken the reliance of the operator on the curative powers of nature. Against these evils it behoves every upright man most carefully to guard himself; to watch with a just and jealous eye the welfare of the patient, whom circumstances have consigned to his charge, and to identify himself with his cause; to discard from his mind every thought or inclination, that may tend to divert his judgment from the one only consideration which should engage it, viz., *is the operation necessary?* or does it hold out the promise of benefit, which will more than counterbalance the evils of its performance? If the judgment of the surgeon waver in its decision on the question, a consultation with the highest accessible authority should be resorted to, with a view to bring the matter to an issue. Diseases for which large operations are required, and are performed, are for the most part serious in their nature; the presence of which may be supposed liable to become either fatal to life, or to the utility of a part on which health more indirectly depends. The removal of such a disease becomes, therefore, a question of "life or death," as it is called; and the restoration to health of a man holding an important rank, or in the performance of important functions in society, or the mother of a large family, whose future happiness depends on her resources to carry out her own scheme of education for her children, is almost equivalent to a gift of a new life to the affected person. And even when a disease is more remotely injurious, as the cause of continued suffering from pain, or even from what we term irritation, although it may not be in its nature injurious to life, still the benefit conferred on a patient by a successful operation, is distinct in its nature, and larger in its effect, than the successful treatment by the physician of even an equally serious disease; inasmuch as the former, viz., that by surgical operation is sudden in its effects, and critical in its agents, and is brought about by means more widely removed from the curative agents employed in every-day life. All this gives both *éclat* and emolument to the surgeon; and how many members of our profession may trace the success of their past career, to the early performance of a good operation on an opulent and generous neighbour!

It will readily be granted, then, that the greater the service rendered, the greater will be the prospect of mutual benefit to the surgeon, and to the patient; and looking to the frightful alternative of failure, by which a person, who at the earnest recommendation of his surgeon has submitted to a large operation with a view to prevent a future and contingent evil, is laid upon his death-bed, the no infrequent issue of "operations of expediency," does it not behove the operator to call forth, either in his own person, or in that of others, the exertion of the soundest reflection, and the most calm and disinterested judgment?

**Requisite qualifications for an operating surgeon.**

The requisite qualifications for an operating surgeon are partly moral, partly intellectual, and partly physical. Moral, indeed, in the most extensive application of the term, whether applied to the government of himself, or to his relations to the world.

A man is disqualified for these duties who cannot divest his mind of the sense of all personal advantage accruing to him from the performance of an operation—who cannot in imagination place himself in the position of his patient, and reflect on the case in all its bearings, and calculate the result as though his own personal health were directly involved. The moral relation of the surgeon to his patient also forms, in many examples, an important item in the calculation of the issue. The larger the share of confidence entertained by the patient in the skill and resources of the surgeon, the more fully will he be able to divest his mind of apprehension, as to the result: he convinces himself that the operation has become a necessary evil, leaving no reasonable alternative to its performance, and he buckles on his armour for the effort. At such a time a man is an object of just and natural sympathy; and it is rare that sympathy does not tell beneficially upon his mind, provided its expression does not betray, on the part of the surgeon, a nervous disquietude, lest the extent of suffering be greater, and the issue more uncertain, than has been represented. A peculiar kindness, and in the example of a woman or a child, even of tenderness of manner, begets a confidence, which, without betraying weakness or uncertainty, fortifies the patient's mind, and reconciles it to the effort.

Anatomical knowledge indispensable.

A perfect knowledge of what he is about to undertake is among the most important requirements of the operating surgeon. The nature and form of every operation should be thoroughly determined on, before it is commenced; and under the circumstances of any unusual form of operation, or of his own limited experience in such as may be common to others, every detail should be made the subject of his anxious deliberation and forethought. A large experience can alone supply the place of this practice. But no previous study or reflection can supersede the necessity of a perfect intimacy with the structure of the region about to be operated on. A surgeon may get through an operation here and there, who is ignorant of the anatomy of the part; but no man can aspire to the reputation of a successful operator, who is not familiar with the anatomy of the entire body, and who not only knows under what circumstances he may endanger life by the division of important structures, but who possesses that almost equally important knowledge, viz., where he may divide and dissect without danger. This negative knowledge is valuable, because, as it insures confidence in the informed surgeon, it enables him to proceed rapidly and boldly onwards in the execution of his task, avoiding an evil incidental to bad operators, viz., that of *picking* in pieces those structures, that should be freely and rapidly divided by the knife.

Manual dexterity.

Dexterity of hand, natural or acquired, is indispensable to a perfect operator. By the term "dexterity of hand" is meant the power of entire command over its movements, which should be at the same time firm, but light and graceful, the sensibilities of which can best appreciate the nature, and the kind of force required on applying the edge of a knife to a surface to be divided. There is no doubt that this power may be greatly cultivated and improved by art; but it can only prevail in perfection, in men naturally gifted by its possession. This freedom and play of the hand is closely allied to that exhibited by some youths, who possess a remarkable facility of penmanship. Both the knife and the pen require the same freedom of movement, and are similarly held. As a general rule, a good caligrapher possesses the manual requisites for a good operator. By far the best school for operative dexterity is the dissecting-room, in which the hand has, from early practice, acquired the power of implicit obedience to the will. It is, perhaps, only in a long experience of these duties, that the hand will be able to adapt itself with facility to all the varieties of movement which operative surgery demands, and which it instinctively adopts, in the course of a protracted operation. Dexterity of hand is the sum total of an exact and perfect command over the agents of flexion and extension, of both hand and fingers, joined to a natural grace in its movements, which not even experience can furnish. To this dexterity, superadd long familiarity with the nature, density, and resistability of the structures to be exposed, by which the force of the knife is regulated, and we have some of the physical requisites of a good operator. Dissection alone can teach us, not simply the movements of the knife as effected by the hand, but the real use and value of the instrument. An unpractised operator is in difficulty, unless his knife be fashioned after a particular form, and retain its perfect edge. The experienced operator, if it may be so expressed, can *get more out of a knife.* It will continue longer obedient to his will; it will do more work, and is less damaged by *his* actions, than by those of another man.

Dissecting-room the best school.

Firmness of purpose.

To natural or acquired dexterity of hand, and an intimate knowledge of the structure of the body, should be added by the operator the yet further requisite of self-confidence; confidence in his own powers, and confidence in his possession of all the requisite knowledge, to carry out his end. He should possess great firmness of purpose, founded on the only solid basis of rectitude of intention; a command of resources against difficulty or danger, to be acquired only by previous thought and preparation, and a self-possession which no accident, however unlooked for, can disturb or alienate.

Silence.

From the first moment of the operation, up to that of its completion, the lips of the operator should be closed to the discussion of all matters not requisite for its furtherance. The occasion is a grave one. He has one end only in view, viz., to complete his painful task, and place his patient at rest. He should not comment on his tools, nor give tongue to thoughts most inapposite to the occasion; as such opinions on the nature of the disease, or the anatomical names of the parts exposed. The occasion should not be employed for the purpose of a demonstration to pupils and juniors. His directions, if necessary, should be given to his assistants plainly, briefly, but intelligibly; and nothing more should be said than is absolutely requisite; for talking and acting antagonise each other, and the more latitude permitted to conversation, necessarily the greater the length of the operation. One authority alone should prevail. All necessary consultation should be held, and all necessary directions should be given, in the absence of the patient; and if in the room used for the purpose of the operation, before his admission to it. If the operation have been well conceived, and clearly sketched in the mind of the operator, there will be no excuse for deviating from these rules; but in all unusual operations, particularly in that of removal of large tumours, critically placed, and intimately connected with surrounding parts, which baffle previous calculation, and in which a perfect knowledge of the anatomical relations of the part can alone carry the operator through it with credit, here, a consultation with his colleagues or assistants may become necessary in the course of the operation:—unless the patient be rendered insensible, and unconscious of what is passing, the chief parties should retire into an adjoining room, and confer with each other, the difficulties in the path of the operator be quickly and briefly stated, and the operation resumed as early as possible. These remarks will equally apply to hospital as to private practice.

Arrangement of instruments.

Previous to the operation, the instruments to be employed should be laid out on a small table; every description of instrument and appliance that may possibly be called into requisition, should be arranged on this table, the variety of which will give evidence of forethought. A list of the instruments to be employed, including every form that contingencies may require, should be written down, in order that the operator may have at hand every agent by which to prevent interruption in the course of the operation. The table should be placed within reach of the operator, that he may assist himself to any instrument he requires, and which want no looker-on can determine so early as himself. Generally, it is better that the instruments be so placed as to be immediately accessible to his own hand, than that he depend on the aid of an assistant for an instrument, which it may require the delay of some seconds of thought to give a name to. Until the patient be placed on the operating table these instruments should be covered with a towel.

**Variety of instruments.**

A plausible objection may be raised to the employment of a great variety of instruments, and especially so when these instruments are complicated in their principle, or in their construction. Simplicity in the construction of surgical instruments, as in all other forms of apparatus, is a desideratum which, in the language of Desault, is "the measure of perfection," but to attain this secondary object we should not sacrifice utility. No doubt men possessing peculiar dexterity of manipulation, may accomplish as much by old and rudely-fashioned tools, as others by the aid of more refined improvements in art. We may have variety, however, without complication; simplicity of construction, with number, from which the most eligible may be selected.

For example, in the attempt to pass a ligature under the subclavian or iliac arteries, it is impossible, before the artery be exposed, to select one form of needle that may not be justly superseded during the operation by another. The surgeon, therefore, should have several at hand, from which he will select that most suitable to his wants. I conceive, therefore, that the objections to variety of instruments are ill-founded and unjust; and that a surgeon ought to possess every form of instrument that may facilitate his progress throughout a difficult operation. While I am prepared to acknowledge that the artificial assistance from instruments forms a bad substitute for what ought to be effected by the hand alone, and with most surgeons is effected by the hand, yet it cannot be denied that instruments which can represent the hand, and that can be efficiently employed beyond its range, within the orifices of the body, should not be discarded as unworthy the resort and employment of the operating surgeon.

Almost every operation is better performed in the recumbent position of the body, whatever the locality of the disease, and especially if it be likely to become protracted; for however bold and resolute the subject may be at its commencement, yet loss of blood and continued suffering beget languor, and a total loss of resolution during faintness, which is the more probable attendant on the sitting than the recumbent position; the patient is of course liable to slip down, and create confusion and difficulty.

Selection of the table.

Much of the comfort of an operator—a consideration of great moment—will depend on the selection of the operating table on which the patient is laid during the operation. It should be neither too narrow, by which a sense of insecurity will be felt by the patient, nor too broad, which compels a forced position on the part of the operator. A table too high or too low, has obviously equal objections. Whatever form be selected, its strength and firmness should be ascertained before the patient be consigned to it. It should be made as comfortable as possible, by means of a blanket repeatedly doubled, and covered with a sheet, and the head of the patient may usually be supported on one or more pillows. I have seen a table literally come in pieces in the middle of an operation, and the patient fall to the ground.

Choice and duty of assistants.

It is the duty of the operator to assign to each assistant his share in the undertaking; to place each in the position in which his duties are most readily performed. That of the chief assistant consists in what may be termed, *multiplying the hands of the operator*, by the addition of his own; his duty is with the wound, the progress of which he should vigilantly observe, and endeavour to trace the current of thought passing in the mind of the operator, and to second his wants. In fact, he should realize the idea of one mind acting by four hands instead of two; so entirely should his actions harmonise with those of his principal. If the hands of a second assistant be required in, or about the wound, the two should have distinct, even if corresponding, duties, assigned to them; but neither should exceed his duty by the interference of word or act.

If the assistant become cognizant of any untoward circumstance in the course of the operation, unseen by the operator, such as the occurrence of hæmorrhage from a large vessel, or the incomplete division of a part supposed to be clearly divided, or the unsuspected proximity of a large artery, the fact should be communicated to the principal, by a look or a single word. To another assistant will be assigned the less important duty of providing a succession of clean sponges, of which an ample supply of the best and softest kind should be furnished. It is a part of his duty to ascertain that a sufficient quantity of hot and cold water is at hand, or readily obtainable, with basins, slop-pails, &c. In serious or protracted operations, a fourth assistant may be profitably employed in personal attendance on the patient, whether for the purpose of holding his hands, or of administering such cordial or stimulating drinks, as may be directed by the principal, regulating the temperature of the room, &c. To one or other of the above should be consigned the responsibility attached to the administration of chloroform, and the continued observance of its effects on the patient during the operation. As a general rule it is desirable to repose this duty to the charge of one person exclusively. The assistants, however, should be careful not to trespass unnecessarily on the area required for the respiration of the patient, by which his sufferings are considerably augmented, and the tendency to fainting promoted. This evil is often considerable; as the operation proceeds it may become more and more critical, and the interest of the bystanders becomes more intimately engaged; at such a moment we are apt in the intensity of our attention and in our anxiety to witness every stage of the operation, to draw into a smaller circle, and thereby encroach injuriously on the area requisite by the patient for healthy respiration. In more than one protracted operation I think I have seen the neglect of this important rule of practice contribute to a fatal issue.

**Daylight most desirable.**

It is very desirable to select a good daylight for the performance of every operation; and, generally speaking, the earlier the hour selected in the middle of the day, the better. By this arrangement we avoid the natural exacerbation of evening. The objections to operations by candlelight are great and manifold: first, the exposed parts present a different aspect to the eye, from that which we have studied; secondly, artificial light, however brilliant, is both dazzling and imperfect, throwing a shadow on parts not immediately exposed to its rays; and thirdly, it occupies on minor matters the attention and charge of assistants, whose duty consists in acts of more direct co-operation with those of the principal surgeon.

If the hour selected be necessarily a late one in the day, the probable duration of the operation should be calculated; and, as such calculations when made are almost invariably wrong, at least double the calculated time should be allowed before sunset; this being the latest moment at which it should be commenced.

Summer season objectionable.

Although the necessities of the case ordinarily preclude our selecting the season of the year for the performance of an operation, yet it is proper to observe that all seasons are not equally eligible; and it would be well, if possible, to avoid selecting the summer, when unusual heat prevails, the influence of which on the nervous and circulating system of a patient, cannot be otherwise than injurious. Perhaps the majority of cases, such as large tumours, stone, aneurism, &c., might be subjected to the postponement of a week or two, without disadvantage.

Disposal of the patient after the operation.

In all cases of operative surgery, in which the operation is considerable, and likely to be attended with loss of blood, or to occupy much time in its performance, every arrangement necessary for the disposal of the patient on its completion should be previously made. The bedroom and bed should be prepared for his reception, and his own dress be suited to it. It would be difficult to imagine a wound which, however carefully brought in apposition, would not be more or less deranged by the simple exertion of changing a day- for a night-shirt. Hence the necessity for looking to every contingency, with a view to avoid the effects of violence. For example, it is most desirable that an operation be performed in the bedroom which the patient is to occupy, or in a room contiguous to it. Among other important requisites is that of a good nurse.

Responsibility of the operator.

It should be fully understood, that the operator alone is responsible for the success or failure of an operation. He cannot plead the directions or advice of a physician, who may deem the operation requisite. The physician may transfer the case for the consideration of the surgeon, who may undertake it or not, as his opinion may lean favourably, or otherwise. Mr. Abernethy, in referring to this subject of medical ethics, used to mention, that he was one day sent for by a physician to tap a lady for ovarian dropsy ; examination convinced him that the contents of the cavity were too viscid to pass through the largest canula, and declined the operation, to the indignation of the physician. The lady shortly afterwards died, and a post-mortem examination proved the correctness of his diagnosis, and the futility of the proposed attempt to relieve her. But far more frequent, and indeed more critical in their consequences, are cases of diseases of the chest demanding the operative aid of the surgeon, whose services may be required on the instant to evacuate collections of water or pus from the cavity of the pleura. Before undertaking to perform the operation of paracentesis thoracis, the surgeon must himself be convinced of its necessity. He should be no less acquainted than the physician with every sign, and every indication pointing to the operation as the only alternative to recovery, or at least to the relief of the urgent symptoms pressing heavily on the vital powers.

Such knowledge, however, is less imperative on the part of the operator, when the medical attendant is a man of acknowledged eminence or authority; but I have witnessed so many examples of failure owing to the absence of such exact diagnosis as alone can justify surgical interference, that the rule should be rendered imperative on every surgeon, who undertakes this important operation at the instigation of another.

In taking charge of a case from the hands of another medical man, the operating surgeon takes with it all the responsibility that the case may entail ; and he should obtain the entire concurrence of his own judgment before he undertakes its charge. This principle requires the stricter observance in the transference of cases from the physician to the surgeon; first, because the question of operation may be of vital moment to the patient, arising from the fact that the practice of the physician is such as involves the consideration of organs, the health of which is indispensable to life ; and, secondly, because from the nature of his professional duties, a physician can afford us little aid, consequent on his inexperience in the difficulties of operative surgery; nor is it to be expected that he will volunteer unnecessary responsibility. The suggestion of an operation by another practitioner, whatever his rank or position, is no warrant for its performance: unless the conviction of its necessity be brought home to the mind of the surgeon, he may decline it. The exposure of the cavities of the body, especially, cannot be effected without danger to life.

Take, for example, a case in which a foreign body has lodged in the bronchial tube, the diagnostic signs of which are often very difficult, and in which a surgeon is called on to operate for its removal. The history of the case should be given him—the symptoms detailed—the grounds of the opinion, and all obtainable evidence and indications, clearly exposed before his view. While it is the duty of the physician to endeavour to convince him of the indispensability of the operation, it is equally his duty to weigh the danger of the undertaking. Confidence in the just eminence and competency of the physician will go far towards influencing his mind as to the desirableness of the attempt proposed; but he should place in the opposite scale all the surgical difficulties that may be reasonably urged; he should weigh his own responsibility, and calculate his own powers. The authority of the physician, if based on acknowledged experience in his profession, and a superior intelligence, should be allowed its full weight on his mind; but it cannot supersede the necessity of his obedience to a conviction, that his own professional duty permits him no alternative but its performance.

Candid dealing with patients on diseases of a doubtful issue.

Operative surgery not infrequently involves interesting questions of medical ethics. The duty of the surgeon should be clearly defined in those frequent examples of operation for disease, of which the ultimate result is doubtful. His opinion should be stated in the most unreserved and candid terms—the chances of recovery, both immediate and remote. However desirable it may be, that the mind of the patient be animated by a full share of hope and confidence in the issue, this desideratum cannot justify his withholding the honest and unreserved declaration of his thoughts and opinions. Take the example of schirrhous disease of the breast, or elsewhere. The removal of such disease may be recommended in favourable cases, such as those in which the diseased parts are nearly or entirely insulated, or in which the neighbouring glands are free from contamination.

It may be truly argued in favour of the operation—first, the uncertainty of the nature of the disease, should it admit of a doubt (and no form of surgical knowledge is at the present day more imperfect than that of the nature of tumours); and, secondly, the possibility that, being cancer, it may not return at some future day. Against any unreasonable objection on the part of the patient, the surgeon may direct the full force of his arguments; such as the fear so frequently expressed by patients, that they shall die on the table. This is a legitimate subject for persuasion; but under all circumstances in which a patient is compelled to rely on his or her own judgment in the decision, whether an operation shall or shall not be undertaken, it is, I conceive, the duty of the surgeon, and no less his real interest, to throw off unnecessary responsibility by a truthful statement of his opinion, which shall conceal nothing. We may contend against morbid or overcharged apprehension, or against weak anticipations of contingent evil; but we should not conceal nor withhold the evidence of the just probabilities of the future, nor contend, by argument or entreaty, against the deliberate decision of our patient, founded upon the candid declaration of our own opinions, in all cases expressed either to the patient or the friends.

**Advantage of enlisting the patient's friends on the side of the operator.**

There is one mode of meeting this difficulty which may often be resorted to with success; it is that of rendering the patient's family or friends the medium of communication between the surgeon and the patient. There are manifest advantages obtained from this kind of relation between the principal parties. First, the surgeon can speak more freely and unreservedly to persons only secondarily concerned; secondly, he obtains the exercise of the calmer and more disinterested judgment of one who is equally desirous of weighing every probability, and more competent to meet the occasional idiosyncrasies of a patient's mind, and who, in the exercise of the right of a parent, relative, or friend, may urge the expediency of the operation in more positive terms than could be justly employed by the surgeon; and, thirdly, should the operation be determined on, it enables him, in the commission of a "pious fraud," to qualify the prospect of liability to a return, and to infuse confidence and hope into his patient's mind.

Conduct towards children in the absence of their parents.

In the case of children, also, difficulties arise which involve moral considerations. Let us suppose the case of a child who has sustained an injury from machinery, and in whom it is, in our opinion, essential to its recovery that an operation be immediately performed, the parents living at a distance and in ignorance of its state. In the absence of the natural guardians of the child, the surgeon becomes the representative of the parent, and he should act upon the best judgment he can arrive at.

This difficulty, not very great in the above relation of the parties concerned, becomes more urgent when the child has reached that period of life at which he begins to throw off the authority of his parent, and to assume his own. The date of this change has no fixed term, but depends both on the moral and on the intellectual development of the child. I have known examples of boys of thirteen, fourteen, or fifteen years of age, the subject of serious laceration, the consideration of which has involved the question of amputation of a limb. Imagine a boy so circumstanced, young, but precocious, deprived of the advice and authority of a parent, who declares that he will not submit to an operation, but would prefer to die rather than lose a leg. How should the surgeon act? Is he justified in doing that which his knowledge and experience tell him is right to be done? Supposing the earnest recommendation of himself and others to have failed in obtaining his patient's consent to the removal of the limb at this equivocal age, and compelled to act, I think he should represent the side of reason, assume the position and the functions of friend or parent of the boy, and compel him to a course to which he would unhesitatingly subject his own child.

The sentiments of the parent, on his arrival after the operation, may correspond with those of the son expressed before it. He may ask, with some appearance of reason, by what authority did the surgeon remove his child's leg against his own consent, or that of his parent? The answer is, that the operation was necessary to the preservation of the boy's life; that it did not admit of delay, and that, in the absence of the parent, the authority of the boy was insufficient to outweigh the decision of reason and experience; thus presuming that the restoration to its parents of the mutilated person of the child is preferable to the almost certainty of his death, should the surgeon yield to his wishes. This decision, however, would be greatly modified, supposing the injury sustained to be less unequivocal. The doubt of the necessity for an operation should be thrown into the scale of the boy's unwillingness to undergo it; and it should be foregone, or at least postponed, till the parent's sentiments be ascertained.

There is yet another relation between the surgeon and his patient that demands a clear perception of professional duty. A patient presents himself before a surgeon, and requests him to undertake an operation which the surgeon may deem unnecessary, or, indeed, unadvisable. The request may assume the character of entreaty; the surgeon may yield, and the patient die in consequence of an operation which the judgment of the operator did not fully approve. The answer is, "I undertook it at the earnest solicitation of the deceased patient; I am not responsible for consequences which were clearly announced to him prior to the operation." This is an error both in medicine and in morals. There are few exceptions to a rule that awards to the surgeon the entire responsibility of every operation performed by his hand. To undertake the removal of a limb, or even of a tumour, at the entreaty of a patient—urged contrary to the advice of those whose knowledge of the consequences is superior to his own—is to participate in his delusion and to become the instrument of his folly. The duty of a surgeon compels him to restrict himself to the employment of a knife in such cases as he has reason to believe will be benefited by its use, and those only. A man of high mind will never claim from his patient any support beyond consent. There is something humiliating under such circumstances in yielding to *solicitation.* It is a prostitution of our high calling. And still more reprehensible is the consent obtained for the performance of a large operation on representations disingenuously, however ingeniously, made, and the object of which is to transfer the responsibility of the consequences from the surgeon to the patient or his friends.

A difficulty occasionally arises between two or more medical men, which also involves a question in medical ethics, or rather of etiquette, viz., by whom shall the operation be performed? Should the patient select an individual, the question is readily settled; but patients rarely interfere between the parties, taking for granted the matter-of-course arrangements of the profession, determined on between them at the necessary consultations that ensue. If this consultation take place between two surgeons, one of whom only is notoriously in the habit of operating, the case would be transferred to him by his colleague, and on the operating surgeon would rest the responsibility of the case. If the operation be one of lesser moment, and his colleague in the case propose himself to undertake it, and to which, under all circumstances, he has the first claim, provided he has the concurrence of his patient, his intention should be clearly expressed at the first interview between them. Between two or more surgeons engaged, priority would determine the person of the operator. On the operator, or his representative should always devolve the after treatment, unless by express arrangement to the contrary, who should become responsible for the principle of his treatment being carried out, whether effected by his own hand or by that of another person under his advice and direction.

Chloroform.

One of the most interesting questions connected with the subject of operative surgery, relates to the resort to the anæsthetic agency of chloroform, æther, &c., employed for the purpose of suspending the function of sensation. This question has assumed a moral as well as a medical type. It has been urged, that sensation is a natural function of the living organism, and that to suspend it by artificial agency is to set at nought the ordinances of nature; and that man is born to suffering, as evidenced by the sensibilities of his body. If the soundness of this argument be admitted, it would be difficult to draw a line which would define the boundary at which moral and *immoral* suffering meet; or to say, in what form of suffering our remedial agents may be justifiably resorted to. The sensibilities of our frame are not given us by nature to the end of promoting pain, but to enable us to avoid injury. Corporal suffering is no necessary part of the discipline of the mind; nor can it even be generally asserted, that its excess exercises a salutary influence on the character. Every movement of our body instinctively points to the avoidance of bodily suffering; why, therefore, should we not as readily and unobjectionably employ the agency of anæsthetic medicines for the purpose of suspending bodily pain, under the circumstances of an otherwise painful operation, as we endeavour to mitigate the bodily suffering of any other patient, cast down on a bed of sickness. Will not the objection to the anæsthetic action of opium to a region affected by a neuralgic pain, or to the system generally, hold as strongly as that of another agent of the same principle, given to avert the pain of an operation?

The medical arguments against the use of anæsthetic agents have a somewhat better foundation. That more or less determination to the brain, and the circulation of blood in an unnatural condition, results from their employment, is undeniable.

It is also undeniable if the quantity administered be large, and long continued, that symptoms resembling those of coma present themselves, in the form of extreme congestion of the vessels of the face, stertorous respiration, and coma; and it cannot be denied that occasionally their full administration leads to headache, vertigo, and languor of some days' duration; and many cases are recorded in which even death itself has followed their employment. On the other hand, the records of St. Bartholomew's Hospital alone point to its successful administration in upwards of fifteen thousand cases; in not more than four of which, including the aged and the young, the healthy, the infirm, and the asthmatic, has the employment of chloroform left a stain on its character as an innocuous agent of good. Under all circumstances, its careful employment may be unhesitatingly resorted to in all cases, excepting only such as are marked by determination to the brain of an apoplectic type; secondly, under circumstances of great and serious exhaustion from loss of blood; and thirdly, in certain diseases of the heart. In these conditions of the system, it is perhaps better avoided.

Exceptions to its use.

The use of chloroform as an anæsthetic agent has now been the established practice of the operating surgeons, and largely also of the accoucheurs in England, for many years, during which the amount of physical pain it has absolutely neutralised, is perfectly incalculable. It is resorted to with more or less caution by nearly every eminent member of the profession engaged in the practice of operative surgery. Still the professional voice is not unanimous in its favour, nor, perhaps, is it to be expected that it should be. It has been attempted to prove that an injurious collapse after large operations, follows its administration, that amputations more frequently lead to a fatal issue with, than without, its employment, that in fact its injurious influence is insidious in its nature by either prolonging the term of convalescence, or, in very severe cases, turning the scale against recovery. It is not to be disputed that the question has been discussed by men of some authority whose investigations have been made known to professional readers; but I may venture to say it is equally true that these investigations are as yet incomplete, the evidence obtained most imperfect, and the deductions equally inconclusive. Suspicions have been raised and doubts expressed, notwithstanding which the employment of chloroform in England and its colonies, and on the Continent of Europe, of ether in the United States, where its properties were first discovered, and perhaps of amyline by its limited advocates, yet hold their position in the unshaken confidence of the surgical community.

One word may be added as to the administration of chloroform. It appears indisputable that its influence on sensation precedes that on consciousness. I have employed it on several occasions, in which a patient has been conscious of all that has been passing around, and yet who has declared himself to have been totally insensible to pain. This state of his system has arisen from the moderate use of the agent, ample, indeed, for all purposes of utility, though somewhat difficult to regulate in quantity sufficient for the required object.

Mode of administration.

I prefer its gradual administration. I consider its application through the medium of a silk or cambric handkerchief laid loosely on the face, preferable to the use of instruments made for the purpose of excluding atmospheric air. I do not know a safer or a more efficient method of applying it, than that of converting a napkin into a large cone, and laying it over the entire face; one or two drams of the spirit being sprinkled over the interior of the cone.

Against the occasional convictions or objections of others to its employment, I place the strong, and to my own mind, the unanswerable fact, that it has been successfully used in so large a number of cases in St. Bartholomew's Hospital since the period of its introduction; that these cases have been indiscriminately taken, and that its objections have not yet made their appearance before the observant eyes of the surgical staff of that institution, either by promoting danger during the operation, or protracting the recovery of the patient, after it. In one class of case its employment is especially applicable; viz., in that form of disease in which the pain of an operation is the chief warrant for its non-performance, and in which the recovery from a chronic disease is left to nature, that might be greatly hastened by the hand of art; such, for example, as the removal of a piece of dead bone.

Up to the period of the introduction of chloroform, a surgeon was very unwilling to subject a patient to the painful process of sawing and chipping away portions of dead bone, with a view to reach the medullary cavity, because the operation was both a painful and a protracted one. The consequence was, that a hospital bed was occupied by a patient thus affected, for many months, to the exclusion, perhaps, of three or more claimants, who would have successively occupied it. By the aid of chloroform the operation is now performed unconsciously to the patient, and the period of his recovery greatly abridged. With the three exceptions above mentioned, I cannot hesitate in strongly recommending its administration in all cases of large surgical operations, believing its discovery to be the greatest blessing conferred on the profession of surgery during the last century; and although I have seen its employment pushed, on many occasions, to the apparent verge of dissolution, I cannot say, even in such examples, that the good has not largely predominated.

Prior to the administration of chloroform food should be rigidly avoided for a period of about three hours, otherwise we may have to contend against the exhaustion of vomiting; and inasmuch as the process of digestion is frequently suspended from mental causes during the hour or more preceding an operation, in addition to the discomfort, is the liability to suffocation from the imperfect effort to discharge undigested masses of food over the region of the glottis.

Treatment prior to operations.

One of the most important questions connected with the subject of operative surgery, relates to the treatment of the patient preparatory to the operation. It was formerly the practice to subject him to the medical discipline of purgation and deprivation of food, with a view to prevent the occurrence of inflammation. But since the commencement of the present century, more enlightened opinions of the economy have prevailed, and the old system is deservedly exploded. Something however still remains to be done. The purgative system yet injuriously thrives, as the mistaken antidote to inflammatory action, and other consequences of violence to living structure.

There are two states of the health obnoxious to operations—viz., plethora and debility; but of all forms of debility that which is most fatal to recovery, is the *debility of excess.* It is of infinite moment, in determining the appropriate treatment, if any, to distinguish clearly the temporary excitement resulting from a stimulating diet, from the real force of tonic health. In the first, the health is apparent, and not real; it is temporary, not constant; not an essential character inherent in the system; it is obtained by artificial and unnatural agency, and is exhausting in its influence on the vital powers. Every operation, however skilfully performed, is a shock to the system—against the effects of which, no treatment is so effectual, as the reliance on the natural powers of a man's own unimpaired constitution. The agents of reparation must be necessarily more active in the tonic circulation of sound health, than under that of occasional excitement, and consequent prostration. As a general rule, we have more to fear from debility, than from excess, for we have the inflammation of debility, as well as the inflammation of excess, to contend against; and of the two forms, I believe the inflammation of debility, especially in large towns, is by far the more frequent consequence of local injury, or violence. Although I adopt the term "inflammation of debility," I am very doubtful whether it expresses the true pathological con-

Reparatory power dependent on tonic health.

dition of the local change, perhaps more truly expressed by the simpler term "congestion."

The influence of operations on the nervous system, and more especially of "operations of expediency," as they are termed, is generally more severely felt, than on the circulating system, for it is both more insidious and more intractable; and when we recollect that the repeated abstraction of blood, or a large purgation, cannot be resorted to, without impairing, in a greater or less degree, the force of this system, it is obvious, that such depletive agents should only be resorted to, on occasions of necessity, and always adopted with discretion; ever keeping in view the acknowledged principle, that tonic health is the surest safeguard against subsequent mischief of all kinds, and the best and safest guarantee for early recovery. All purgatives that produce liquid evacuations are, at such times, injurious. Whatever, therefore, tends to impair the constitutional powers, tends to injury. The after stages of an operation, particularly those which have been attended with much loss of blood, call for the exercise of all the reparative powers that can be brought into action. In his admirable lectures, Sir B. Brodie advises us to distrust the opinion of a surgeon who, at the close of an operation, asserts that the patient has lost no more blood than will do him good. Any loss is an evil, and, if possible, to be avoided. To reduce a patient by successive bleedings, or otherwise, is to throw a real danger on the latter stages, on the erroneous principle of averting an early one. A dose of laxative medicine for the purpose of simply clearing the intestinal canal, may be reasonably administered, prior to most operations, if only for the purpose of preventing the necessity of any early movement of the person, afterwards. All violent changes, whether of air or diet, should be avoided. Patients should become accustomed to a new locality, before the operation is performed. I have frequently witnessed the injurious effects of operations on patients brought from the country, without this precaution being observed. The shock has proved excessive, and the recovery doubtful, or at least protracted. It is better that he reside for some days, or longer, in the new locality, to become habituated to the change of air, scene, and diet. This, and many of the preceding remarks, are

Depletion to be avoided.

intended chiefly to apply to the larger operations only, such as lithotomy, amputations, and the removal of large tumours. Surgeons recognise a sound principle in the employment of such quietude, whether to a limb, or to the whole person, as may be required in the after treatment of many operations. To a person in health, such confinement is more or less painful and injurious, conducing, on its first application, to a morbid irritability both of body and mind. Much advantage is often obtained by accustoming the patient to the annoyance of this necessary restriction on his movements for some days prior to that of the operation. By such means we cut off—or at least we reduce—one source of evil attendant on its after treatment. The principle is well exemplified by the operation for the removal of loose cartilages in the knee-joint.

Operations of expediency.

By the term "operations of expediency," is understood that class of operations, which are undertaken for the purpose of curing deformity, by the removal or division of sound parts, or of painless diseases, the evil of which does not exceed the level of inconvenience. The principle on which the frequency of the serious, and even fatal consequences of such operations is explained, is that of a shock to the constitution, totally unprepared for it. The nervous system is unconscious of the presence of disease, and suffers in proportion from the suddenness of the shock. The nervous system must take cognizance of its presence ; the patient should have suffered something more than mere inconvenience, in order to its removal with impunity. It behoves us, therefore, on undertaking such operations, to be armed against their probable consequences, and to watch with unusual vigilance for the evidence of their first appearance. These symptoms are confined, for the most part, to the affections of the nervous system, and are often very intractable. I have known death result from the removal of a toe, under the able management of Baron Dupuytren ; and on another occasion, the same result attended the removal by the knife of an enlarged bursa below the patella. For much the same reasons, an incision into a large joint is often fatal to the articulation, causing inflammation, suppuration, and absorption of the cartilage, while we cut into a diseased joint with impunity ; and probably there would be much more danger from an incision into a healthy bladder, than into the same organ containing a stone.

Symptoms derived from derangement of the nervous system.

The knowledge of the symptoms which indicate early derangement of the nervous system, consequent on local injury, whether occasioned by the agency of the surgeon, or occurring as the result of accidental violence, marks the observant powers of the practitioner. Its study is one of the most difficult problems in the practice of the operating surgeon, consequent on the occult and apparently mysterious nature of these signs, which peer out in the form of slight unsteadiness of the pulse, irregularity in the respiration, occasional wandering of the thoughts, loss of the relation between the act of inspiration and the number of pulsations of the heart, and other indications of disturbance, to be detected only, on the closest observation and enquiry. Those symptoms would pass unheeded by the unobservant practitioner, till they reach a height at which they become too palpable to escape ordinary notice, while a vigilant observer detects their earliest manifestations. The value of this knowledge may be inferred from the fact, that the treatment which might be advantageously resorted to in inflammatory affections, and for which the above symptoms are liable to be mistaken, would tend to an increase of the evil, and to shake still more injuriously the stability of the whole system.

Protracted operations.

Additional to the shock on the nervous system, caused in a greater or less degree by all operations, there exist two collateral evils on the occurrence of which the after progress of the case may give considerable trouble and anxiety. The first consists in the danger resulting from the time occupied in its performance, which may exceed the powers of endurance of the subject of the operation; and the second arises from loss of blood. In the first case it should be recollected, that many, or at least some, operations necessarily occupy a considerable time for their completion; that it is far better to prolong the present suffering of a patient, than to leave our task incomplete. At the same time, it cannot be denied, that the protracted length of an operation may be occasionally attributable to the want of knowledge or dexterity of the operator, and for which I can suggest no other remedy than that of placing the knife in other hands; a proposition that requires more than an ordinary share of moral courage, and that few men would willingly adopt.

At the period at which the functions of the animal economy were less understood, the value of blood was less highly estimated than it is at present. It has now become a recognised rule of practice to exercise the utmost caution in preventing unnecessary loss. It would be difficult to obtain evidence of benefit to be derived from the neglect of this law in any form of operation, or to deny the truth of the acknowledged fact in medicine that just in proportion to the quantity of blood which escapes from the circulation during an operation on a healthy person, always supposing the quantity to be considerable, so may we anticipate difficulties and obstructions in our after treatment of the case.

Hæmorrhage.

The consequences of excessive hæmorrhage should therefore be carefully guarded against. The degree of attention bestowed on this probable cause of future evil, will much depend on the sex, age, and constitution of the subject. If the subject of the operation be a delicate woman, or even a man reduced by long suffering or depletion, and still more emphatically may I urge, if a child, *no precaution tending to the prevention of loss of blood should be neglected.* The best means of contending against hæmorrhage, is that of completing the operation as quickly as possible.

At the same time, however, it may be observed, in extenuation of slow operators, that the loss of blood is not always in a ratio with the length of time employed. The quantity of blood lost in a quickly executed operation, is greater, if compared with the time occupied by it, than in a prolonged one. For vessels do not continue to bleed with the force that attends their first division, arising partly from the diminished power of the heart, and partly from their gradual contraction; and vessels of considerable calibre, that pour their blood freely into and around the wound, and the jet of which may reach the bystanders at a distance of some four or five feet, quickly lose their force of pulsation, and finally, often become so reduced in size and importance, as even to prove unworthy the application of a ligature.

Relative value of loss of time and loss of blood.

The necessary consideration due both to speed and safety, (which are not infrequently synonymous terms,) may occasionally require the operation to be arrested, for the purpose of tying a wounded vessel, the bleeding from which interrupts its progress. We have an example of this, in the superficial pudic artery, often divided in the first incision in femoral hernia; but it should not be resorted to unnecessarily, and especially so when the subject is a strong and healthy man, and the operation is of a nature to promise early completion. The lesser subject of position should also weigh in determining the relative importance of loss of time and loss of blood. If the position of the patient be an irksome one, such as that on the face, or with the limbs forced into an uneasy and violent angle with the body, or such as requires its being retained by bandages; in a word, whenever there exists any additional draught on the powers of the nervous system, then the question of time should prevail over that of loss of blood, unless forced on us by the peculiar liabilities of the patient.

In operations which have entailed considerable loss of blood, the condition of the pulse should be carefully noted. If so far reduced as to give indications of fainting we should have recourse to stimulants, of which a small wine-glass of brandy diluted with about an equal quantity of water should be given, and repeated, if necessary. Brandy is preferable to wine, which is very frequently followed by vomiting. This was also the remark of Mr. Abernethy.

After treatment.

The after treatment of operations should be dictated by common sense. For the same reason that operations which were formerly of frequent occurrence, are at the present day rarely resorted to, by reason of our improved knowledge of the powers of the economy; so the old and complicated practice of after treatment has given place to the employment of more simple, and at the same time more efficient agents. We rely on nature, rather than on art. It is a part of this improved principle to eschew large and heating local applications; to promote comfort, rather than warmth; to *consult ease;* to forego the mistaken agency of medicine; to arrest hæmorrhage by the careful application of appropriate means, and to tranquillize the nervous system; in short, to follow nature, and not to attempt to lead her. Extra vigilance will be required in cases in which a large quantity of blood has been lost, because it is in such examples that we look for sinking, and the effects of prostration, and their too frequent concomitants, low forms of local inflammation. Generally speaking, the earlier we can supply the lost blood to the circulation the better; and this can only be effected by the administration of nutritious food, which, for a time, the patient is indisposed to take; but when present, the inclination should be indulged to the extent of appetite, and hailed with pleasure, as the happiest testimony to the rallying powers of the constitution. I cannot, while on this subject, withhold my protest against the employment of simple decoctions of meat, beef-tea, for example, as efficient agents of nutrition, with which patients, panting for nourishment after loss of blood, are indulged. If a basin of beef-tea, or ordinary thin gravy soup, be given to a hungry boy, it will be found that his appetite for solid animal food is almost unshaken; he will subsequently consume his usual quantity of meat. I do not dispute the authority of Liebig and other chemists; I only state the results of my observation. If a patient express a natural desire for food, nature may safely become our guide, and his appetite should be indulged, in moderation. The merit of beef-tea is rather that of a vehicle for more nutritious food, in the form of bread, maccaroni, or rice: one or more eggs, beaten up in milk, or isinglass, to which two or three teaspoonfuls of brandy may be added, on the second or third day. Such food allays appetite, nourishes, and tends to the regeneration of the lost blood.

Inefficiency of decoctions of meat to supply the loss of blood.

Thirst.

Thirst is an earlier indication of the want of nourishment to the circulation, after loss of blood, than hunger. After depletion of every kind, the desire for liquids precedes that for solid food, probably because it is more readily and more quickly absorbed into the circulation. To withhold drink from a person suffering painful thirst from depletion, is to interpose the erroneous principles of art, in the path of a distinct and natural indication, and can only be attributed to ignorance of the functions of the economy. The drinks employed at such seasons should be rendered slightly nutritious, such as whey, or milk and water; and as soon as all danger is past, namely, about the third or fourth day, I have often known a glass of table-beer, or even draught-porter, if the patient has expressed a desire for it, effect substantial and permanent good.

Contra-indication of purgative medicine.

Neither should the bowels be teazed with aperient medicine. *Constipation is the general consequence of loss of blood.* It is by no means desirable that a patient have a daily action of the bowels, after considerable depletion. This constipation is a law of nature, palpable, and never failing. Nothing can surely be more readily understood than the principle, that nature suspends the excretions, with a view to supply, by every absorbing means in her power, the blood that has been removed. This principle, so natural and so admirable to its end, is not infrequently thwarted by the arrival of a dose of calomel, and a "black draught" for the following morning, which, to prevent all mistake, should be immediately consigned to the depths of that recess, to which its action would have driven the unfortunate patient.

It is difficult to know what form of medicine to administer, that will not do harm ; an occasional sedative being all that is required, and that not invariably. Purgatives, diaphoretics, tonics, antispasmodics, diuretics, one and all, are generally speaking uncalled for, and in a greater or lesser degree prejudicial to recovery.—(See chapter on After-Treatment of Operations.)

# CHAPTER II.

ON THE USE OF THE KNIFE—FIRST POSITION—SECOND POSITION—THIRD POSITION—VARIETIES OF THE INSTRUMENT—SIZE AND STRENGTH OF THE KNIFE PROPORTIONED TO THE MAGNITUDE OF THE REQUIRED WOUND—BISTOURY, SHARP, AND PROBE-POINTED—DIRECTOR—FORCEPS, VARIETIES OF—SAW, VARIETIES OF—ELEVATOR—PROBE—BONE FORCEPS—OBJECTS ATTAINED BY ITS USE—GROOVED NEEDLE AND MINUTE TROCAR—OPEN NEEDLE—ECRASEUR, OBJECTIONS TO ITS USE—BLUNT-EDGED KNIVES—LIGATURES—SPONGE.

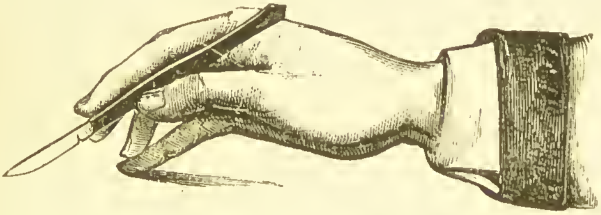
THE knife being the instrument of most general use in the performance of all surgical operations, it is necessary to say a few words on the manner of wielding it to the best advantage, and of adapting its edge most aptly to the kind of surface to be divided by it. Its offices are required to divide parts in many different ways;—in cutting, paring, puncturing, dissecting, &c.; it is employed with firm or with light pressure, dividing masses of cutaneous and adipose structure, fascia, &c., or separating hard textures. To effect these various objects with elegance and dexterity, certain modifications of its position are required, as appropriate to each. The practice of these modifications, or varieties of position, is almost indispensable to the progress of the operation; and although they are in some measure adopted instinctively by the dexterous manipulator, to whom they appear natural; yet it may be desirable to lay down general rules for their selection, for the benefit of those, who have either little experience in the use of the knife, or are not gifted with a natural dexterity of hand. To dwell at any length on this subject is, however, unprofitable.

Employment of the knife.

To whatever degree of fineness the edge of a knife may be brought by the art of the cutler, it should rarely be employed to divide parts except on the principle of the saw; which, in reality, tears minutely asunder any soft material upon which it is drawn. The nearer the action of the knife be made to correspond with that of the saw, acting however in one direction only, and the lighter the movement, and the less the pressure of the hand, provided the edge be applied, like a saw, nearly parallel to the surface to be divided, the more perfect will be the wound, and when brought into contact, the more readily will it re-unite. A great art in the use of the knife consists in adapting the requisite force to the surface to be divided, and this is much better effected by a light, than by a hard pressure of the hand. The immediate agent of division is the knife, and not the hand. The hand regulates the force, and should employ as little as possible, not for the purpose of saving power, but because, as above stated, the cleanest, and consequently the healthiest, wound is effected with the least pressure.

**First position.**

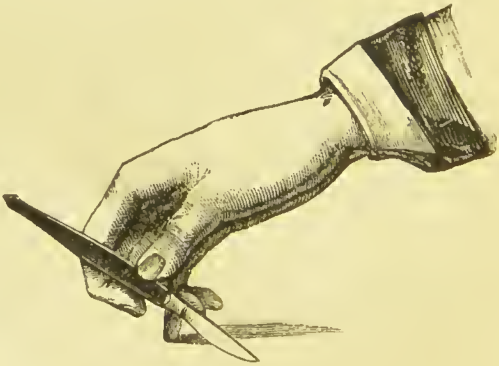
The *first*, and most general *position*, is nearly identical with that of a pencil, or pen when held in the act of writing, in which the instrument is placed obliquely forwards, between the fingers, having the thumb applied on the one surface of the handle, the index finger on the back, and the middle placed somewhat behind, or occasionally at the side, for the purpose of regulating the force employed by the index. The little finger resting on the body of the patient, supports the hand. The index and middle finger antagonise each other's action. In this position we employ the knife for the purpose of any cutaneous incision, requiring the exercise of caution in the degree of pressure. The remark would apply in all operations for hernia, tumours near the surface of the skin, aneurism of nearly every region, Taliacotian operations, and many others. The dissimilarity between this mode of holding the knife, and that of a pen consists in the position of the middle finger, which in the latter rather combines with the thumb and fore-finger in holding the instrument firmly, the pressure of the three fingers being equidistant from each other; whereas, when



applied to the knife in this, the first position, it gives support to the blade and regulates the degree of force employed by the index finger which is the sole agent of pressure. In order to render this position of the knife as efficient as possible, and to be enabled to draw it nearly parallel to the surface, the fingers should grasp the instrument at the extremity of the handle, including a portion of the blade. But this relation of the hand will be modified by the length of the blade, which should be curved upwards considerably, rendering the last inch, if the blade be of the usual length, the really useful and the only employed part of the knife, nearly parallel to the skin. The blade should be short, and the knife altogether strongly and firmly made. In making the incision, if a long one, the hand and little finger should be supported on the skin, and the remaining fingers extended nearly to their full length, in order to prevent the unnecessary movement of the entire hand. By the flexion of the finger and thumb, the incision is effected, which, if of insufficient length, must be extended by the sliding movement of the entire hand backwards. The flat surface of the blade of the knife should be held at right angles to the surface to be divided, otherwise the wound will be carried down in an oblique, and not in a vertical direction, a frequent fault in young operators.

Modification of first position.

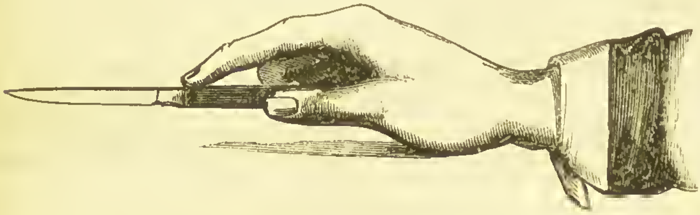
A *second* position consists in turning the blade backwards and the handle forwards, for the purpose of dividing



from behind. The hand is then supported by the little finger extended, the instrument still grasped by the thumb and two first fingers. The thumb, partly flexed, now becomes the agent of pressure, antagonised by the index. It is a modification of the first position, not frequently resorted to.

Third position.

The *third position* is nearly identical with that of a table-knife. The handle of the instrument rests in the hollow of the hand, and the index finger is placed at length on the back of the blade. The handle is grasped in the middle, by the thumb and middle finger, which form the axis of its motion. The force may be applied in two ways, first, by the pressure of the index directly on the blade, and, secondly, by the elevation of the handle into the palm, by the ring and little finger, by which force the point of the blade is still further depressed. Usually, however, the ring and little finger are employed simply to fix the instrument more firmly in the hand. This position would be resorted to, for incisions made to expose deep tumours, or is required in dividing through hard structures, such as the integuments on the back, or for any deep division of parts, of which the nature of the subjacent structure is fully known to be free from danger. Additional facility of division is given to this position of the knife by its parallelism to the surface. The knife is occasionally held like the bow of a violin, in which the thumb antagonises all the fingers. This is employed in incisions, transverse to the person of the operator; and it is also grasped by the entire hand, as in holding an amputating knife. Any further modification of the different modes of holding a knife, on which it is unnecessary to enlarge, may be safely left to the instinctive resources of the operator.



Size and form.

Variety in the form as well as the size of the knife is dependant on the extent and character of the substance to be divided. We employ large and strong knives for large divisions; small, and delicately constructed instruments for more minute purposes. In excisions of diseased mammary gland we use a scalpel, the blade of which is about three inches in length, and attached to a strong handle serrated on its surface, that may be firmly grasped in the hand. In emergencies it may be employed in the case of children as an amputating knife. Fig. 1 represents a full-sized ordinary scalpel employed in a large variety of operations, such as the removal of tumours, exposing deep-seated parts, &c. Figs. 2 and 3 are varieties of the scalpel (the latter double-edged), of lesser size and more delicate in form, which are better adapted for the purpose of puncture. They are especially useful for evacuating the contents of an abscess. Being delicately made in the blade, the wound formed by their introduction is exceedingly small, but may be enlarged to any extent on their withdrawal. Fig. 4. represents a variety of the

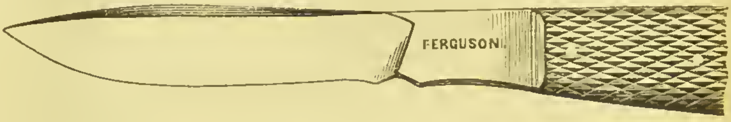


Fig. 1.

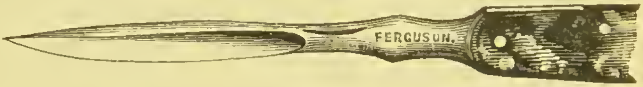


Fig. 2.

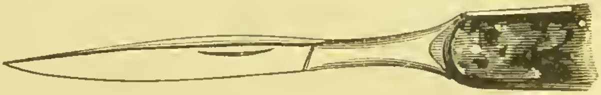


Fig. 3.

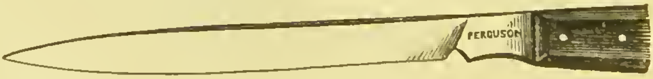


Fig. 4 (reduced in size).

French knife, an efficient instrument for effecting a lengthened division of superficial structures.

In addition to the above comments on the employment of the knife, I propose to subjoin some remarks on the use of other instruments of frequent application by the operating surgeon, all of which are competent to evil as well as to good in an exact ratio with the perfection of their employment.

Bistoury.

*A Bistoury* is either straight or curved, either probe-pointed or sharp. It is employed for the division of parts concealed from view, and for the safety of its introduction through the narrow channel or sinus which it is required whether partially or entirely to divide, its point is carried along a grooved director, either of silver or of other metal; but as the depth of the bistoury commonly exceeds that of the groove, except at its point, it is obvious that the edge of the instrument will be brought into contact with soft parts before the point has reached its destination. This evil is avoided in Sir A. Cooper's hernia knife. In those cases in which it is not desired to divide the structures about the orifice of the sinus, some care should be bestowed on the relative depths of the knife and the groove of the instrument along which it is conveyed, and during its introduction the attention of the operator should be concentrated on its point.

Two methods of using it.

If, with the intention of laying open a sinus, a pointed bistoury be employed, the division may be made either by bringing the point out at once through the soft parts, thus dividing the sinus from its remote extremity backwards towards its orifice, or if probe-pointed by raising the blade out of the groove, and dividing from the orifice towards the remote end.

Of these proceedings, the first is effected the more quickly because in the act of division the bistoury is carried forwards on the opposing textures, on the principle we adopt in the division of parts from without inwards. The incision is clean and in all respects perfect. When the probe-pointed instrument is employed, the handle of the bistoury is raised upwards on the principle of a lever of the second kind, and the parts are divided by its edge on that of the wedge, viz., by simple pressure. Another advantage of the sharp-pointed instrument consists in the certainty of the entire division of the sinus to be exposed, and where, as in some forms of sinuous wounds, there is a great tendency to burrow, it may be desirable to expose the remote extremity of the canal by a division of parts that shall extend even beyond it.

The director.

*The Director.*—The functions of this instrument are so well known that little need be said on the subject. The director, as its name denotes, directs a cutting bistoury to its destination. It is for the most part employed in the laying open of chronic sinuses burrowing among soft structures. Without the aid of the director the exposure of the sinus would be an operation of great difficulty, on account of the division of many parts that should remain undivided. It is therefore an instrument indispensable to every surgeon; without it the bistoury itself is useless.

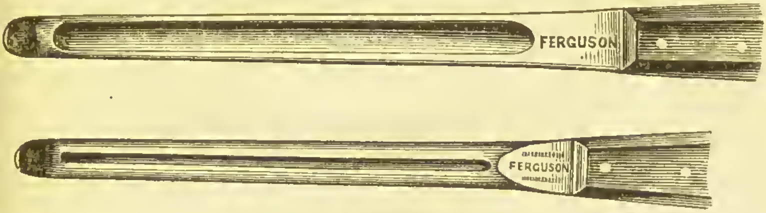
Office of.

The director is generally employed: 1st., to explore the canal to be laid open. By its means we determine direction and depth, we ascertain size, and we learn whether we have to deal with a mere sinus or canal, or whether the sinus forms the outlet of a cavity of greater or less magnitude.

2nd. It is an instrument designed for protection, and with this object the groove should be sunk within it to a depth sufficient to admit the bistoury in its entire breadth, as exemplified in the "bistoire caché." When employed as a guide to the curved bistoury, the director should also be curved, in order that the cutting edge may be carried along it without obstruction to its destination. The director is often employed to direct the bistoury through structures critical in their nature and relations, and it very commonly requires to be raised with some force of pressure upwards against the surface to be divided. By this means a clean division of the parts is effected. When the sinus is long, and especially if deeply placed, the handle of the instrument should be made of sufficient length to be held firmly in the hand.

Flat director.

In the operation for hernia directors of various sizes and depths of groove are in requisition, among which no form is so eligible as the full-sized flat director, the groove in which is capacious, as regards breadth. Such an instrument not only conveys the cutting edge of the bistoury in safety, but by its introduction through the ring pushes aside all structures that the surgeon desires to avoid. A director with a broad groove should also be selected when the division is made by a scalpel from the surface.



Figs. 5 and 6 (reduced in size).

*Forceps.*—When employed to seize a divided artery for the purpose of applying a ligature around it, a pair of fine-pointed forceps should be selected for all vessels that can be readily caught by the instrument. Forceps.

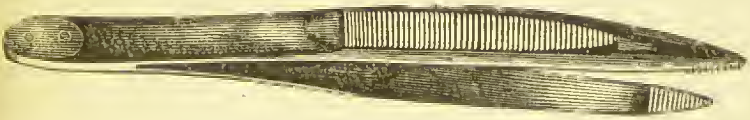


Fig. 7 (reduced in size).

When retraction of the artery takes place we commonly employ forceps with rounded points, the blades of which are connected to each other by means of a spring catch. When the artery is seized, the forceps may at once be locked upon it, and the ligature when drawn tight slips off the end of the instrument on to the vessel.

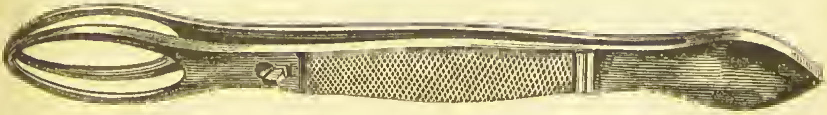
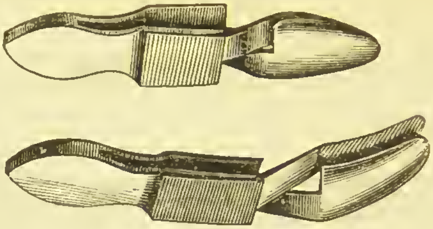


Fig. 8 (reduced in size).

The lesser forceps are self-acting, but are not in frequent request. They are convenient in large operations, attended by hæmorrhage from many vessels, at which there exists a deficiency of competent assistants.

The Assalini forceps is an instrument of value and in frequent requisition.



Figs. 9 and 10.

Saw.

It is worthy of remark how far real competence may characterise the operating powers of many surgeons throughout the early stages of an operation who fail in the use of that common, but indispensable instrument, the *Saw.* The operation of the saw consists in the tearing asunder from the bony surface on which it is drawn a succession of minute fragments, which, being separated in the aggregate, are sufficient to leave a groove in the bone, and by frequent repetition of its movements the depth of this groove is increased until the bone is separated into two parts. It is unquestionable that the greater the force of pressure employed the larger the quantity of saw-dust, and consequently the more quickly will the division of the bone be effected. Therefore some degree of force is a desideratum, but the regulation of this force is the secret of the saw. If the pressure be too great, evils may arise ; the saw may become locked or fixed in the groove, and detached from it not without effort—the violence of the movement may extend its influence to the limb, and soft structures may be injured ; the saw escaping from the groove, especially at the commencement of its employment, may endanger the hands of the assistants ; or finally the instrument itself may break asunder. If we examine the operation of the saw in the dexterous hands of a carpenter who is so familiar with its use, we observe that he commences his groove by a succession of slight but steady movements of the instrument, and no sooner is an impression made on the substance to be divided than he moves the entire length of the saw backwards and forwards in the groove with a steady well-regulated force until his end is accomplished.

In like manner the surgical saw, the teeth or serræ of which are so set as to act on the bone both in extending as in withdrawing the instrument, should be used with a light but steady pressure made on the groove by the successive movements of flexion and extension of the arm, employing at each movement the entire length of the instrument from the heel to the point, *et contra.* These movements should be measured and deliberate. The required force will be better gauged by a moderately slow, than by a rapid movement; the instrument is thus rendered less liable to escape from the groove, and will prove less injurious if it do escape; and taking into consideration all liabilities, the bone will be more quickly divided. In order to avoid the liability to the saw becoming locked, the movements of the arm should be such as to direct the saw in a line perpetually parallel both to the groove and to the surface of the stump, the handle of the instrument being drawn backwards towards the right shoulder. However this must depend in great measure upon the manner in which the part to be separated is held. When the division of the bone is nearly completed, both the rapidity and the force of the instrument should be greatly reduced, and the movements retarded with a view to prevent the bone being splintered. Among the variety of saws we have that with the open back in occasional use, and a form in which the edge is connected at each end by a screw, in order that the teeth may be turned in any direction. Method of using.

*The Elevator* is an instrument in occasional requisition. Its services are limited to operations on bone fragments, which may require to be raised or separated by mechanical power. It may be employed as a lever of the first or of the second kind, in either of which it exercises great force on the resisting structures, a force that may be resorted to greatly to their injury. This injury is the result of want of thought in the selection of the fulcrum, which when made on soft structures must necessarily disorganise them by the violence of the pressure. Care should be taken by the substitution of the hand of the operator to avoid this very objectionable and often injurious proceeding. Elevator.

The utility of the *Probe* depends on its application, both in reference to the manner in which it is handled and the frequency of its employment. It is a valuable Probe.

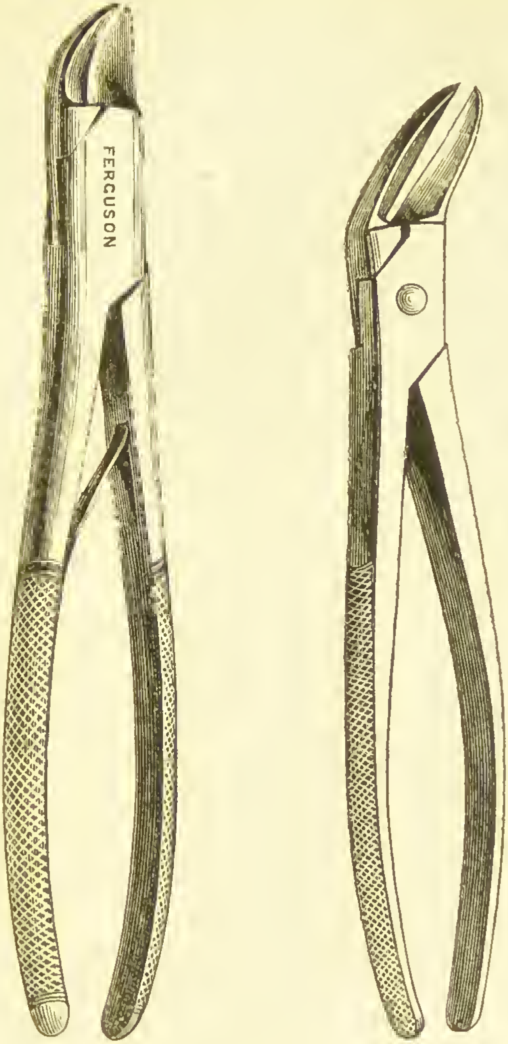
instrument when employed for the purpose of exploring the extent and direction of a wound, but only when the knowledge of "extent" and "direction" can subserve the curative intentions of the surgeon who wields it. When such knowledge is not attainable by its introduction, when it is employed to the end merely of gratifying surgical curiosity, it becomes in the hands of the surgeon an officious and obtrusive instrument of wilful torture.

With some surgeons the introduction of a probe into every morbid orifice or sinuous mouth has become an instinct. The orifice and the probe hold the relation of cause and effect. They appear to possess some obscure kind of affinity for each other. If the probe be required on the first observation and attendance on the case, it appears equally indispensable on the second or third visit. It need hardly be urged that the office of a probe consists in exploring the interior of the body, whenever exploration can be serviceable, and not otherwise. It is often essential to our treatment to ascertain whether and to what extent bone is involved, because it is futile to attempt the obliteration of a sinus, so long as it communicates with, and is the product of diseased bone. But the fact once ascertained the probe may be laid aside, and only again resorted to when it is required to know to what extent progress is being made towards a cure, and under almost all circumstances its introduction should be effected with the utmost care and gentleness of hand.

Bone forceps.

The *Bone Forceps* is an instrument of great power whether for good or for evil. It is employed to separate a bone or its dead fragments, or any morbid products from the healthy structure, and for such purposes it has almost superseded the employment of the saw. The power wielded by this instrument is that of a lever of the first kind, and its degree depends on the relative length of the handles and the blades. I venture on two suggestions, which may serve as hints to its serviceable employment when applied to the removal of bone. 1st., that the soft textures be entirely separated from the bones, in order that the instrument shall have a clear space for its operation; and 2nd., that it be not employed in the capacity of a single lever or elevator, to prize up bone only partially separated. The force of the blade may be sufficient to break down and detach thick portions of bone when the force of pressure is employed in a direction transversely to the blade, whereas any violence applied

Mode of applying.



Figs. 11 and 12 (much reduced in size).

in the opposite, while using the instrument as an elevator, will in all probability break asunder the points.

Another hint may be found useful. It is important to apply the flat sides of the blades to the sound bone, because the bone invariably splinters in the direction of the concavity of the blade. The scooped surface should therefore be applied on the side of the part it is proposed to remove.

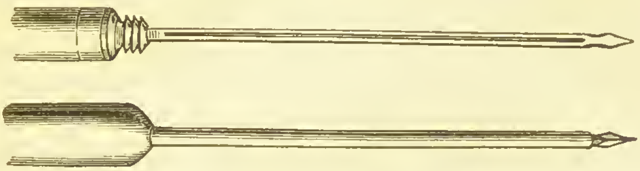
Employed for soft growths.

But the large or bone forceps may serve other purposes in the cause of disease by the removal of soft textures, such as hypertrophied growths of skin, or any morbid growths admitting of such isolation from the body as is obtained by the power of bringing into contact at their base the opposite sides of the integument around them. By such application the bone forceps may be brought into use on the crushing principle of the "écraseur," possessing the more useful qualities of that instrument, and avoiding its palpable defects. These defects, which are stated under the title of that instrument, consist chiefly in the excessive traction of the skin due to the necessary strength of the *chain*, and the disorganising influence of the pressure on the integuments and subjacent textures, and do not apply to the large or bone forceps, the edges of which should be brought into such exact contact when closed, as to preclude the transmission of light between them. If the contact is yet imperfect and a line of light is visible between the blades when closed to the utmost, the division of the intervening textures may always be completed with the aid of a knife. If the integuments can be brought in contact beneath the tumour, without the application of considerable force, there can be no difficulty, when the separation is completed by the knife, in retaining the edges of the wound together by means of sutures, the structures will not be disorganised, and the permanent union will be complete.

By the aid of the bone or large forceps, I have removed, on various occasions, morbid and cancerous growths from the tongue, and hypertrophied portions of skin from the prepuce and elsewhere. The instrument is most serviceable in leaving a clear cut edge, which will readily unite by means of one or more sutures. Such edges are disorganised by the écraseur, an instrument which will be rarely resorted to by the dexterous operator.

Grooved needle and minute trocar.

*Grooved Needle and Minute Trocar.*—These instruments are in frequent requisition by the operating surgeon. By their aid we explore the interior of any morbid structure for the purpose of ascertaining the nature of its contents. Such knowledge is often of great value in the present and subsequent treatment of a disease the character of which is obscure, whether in deep-seated collections of pus, of blood, or of serum, occupying cysts or larger cavities. A fine grooved needle is a most unobjectionable instrument. There is no equality, on the one hand, between the service it renders to the surgeon by throwing light on an uncertain disease, and either, on the other, the pain caused by its introduction, or the subsequent evils resulting from it. The external wound is so small as not to permit the escape of fluid even from a superficial collection. Indeed it can scarcely be said that any evil consequence results from its introduction so long as the integument is healthy, and it might even be passed into an aneurismal sac with impunity. In puncturing collections of fluid critical in their nature, the grooved needle should be made fine at the point and gradually increasing in width towards the handle. The integuments will then be pressed open on the principle of the wedge, and will contract and fill the space so made on the withdrawal of the instrument. Where the needle is formed with shoulders near the point, although more readily passed through the subjacent structures, it necessarily leaves a wider aperture on its withdrawal. Generally, however, this defect is unimportant. Each of these two instruments, the needle and the trocar, has its advantage over the other, the needle in being more readily introduced, the trocar in forming a more patent canal for the escape of the explored fluid. Unless the minute trocar be well made and the canula fit accurately round the trocar, the difficulty of its introduction through the integuments is often great.



Figs. 13 and 14.

**Minute trocar.**

The correct diagnosis of the surgeon is greatly indebted to the exploring needle for knowledge that is unattainable without it. How often has a correct knowledge of the nature of a disease, and the success of its future treatment turned on the employment of the needle or trocar —how often has a projected operation for tumours of various kind been arrested at the threshold by its well-timed use—how great is the confidence it affords to the operator—how great the safety to the patient! The principle of exploration is demanded by the obscurity of disease, and the needle should be resorted to on any or all occasions of doubt. On a larger scale this principle is demanded on the occasion of excision of any growth of a doubtful nature, involving the necessary removal of any integral part of the frame, whether mammary gland, testicle, or a part of an extremity.

Open needle.

The groove should be made deep, in order to prevent the encroachment of the integuments upon it when introduced, otherwise some degree of lateral pressure of the needle is required in order to dilate the aperture in the direction opposite to that of the groove, with a view to allow a freer exit to the fluid. I employ very commonly a needle, the point of which is connected with the handle by two lateral threads leaving an open space or fissure between them. When this instrument is fully introduced, the handle should be rotated one quarter of the circle, and the aperture then completed will permit the escape of the contents without difficulty.

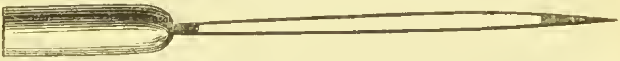


Fig 15.

Needle.

*The Needle.*—The surgical needle is an instrument in so frequent use that it may not be deemed superfluous to say a few words upon its employment and construction. The old curved needle, forming a segment of a circle, is an objectionable instrument simply because, in introducing it, the force *à tergo* should be applied, and the hand should follow in the direction of the curve, and this is difficult if the textures be firm, through which it has to pass, and this evil is greatly increased if the needle be otherwise than perfect at its point. We so habitually employ the force of pressure in a straight line that it is difficult to realise the necessary curve along which the needle should pass. A form of needle with a simple curve or elevation at the point, and involving about one third only of its length, is introduced with far greater facility than the former, not only because the force of pressure is carried more nearly towards the straight line, but because it can be more firmly held in the hand. A needle perfectly straight will often suffice for the purpose of carrying a thread through the opposite integuments of a wound, but whether straight, raised at the point, or forming the segment of a circle, its efficiency will depend on condition rather than on form : the point must be perfect, and the shaft flattened to an acute edge up to the shoulders. Every needle should be tested before it is used, and when the operation is completed, it should be recollected that the needles are entitled to the same care, and to the same attention to cleanliness, that is bestowed on the other and larger instruments.

Ecraseur.

The *Écraseur* (crusher) is an instrument of modern invention, and derived from the French School of Surgery within the period of a few years only. At the present date it yet claims the indisputable charm of novelty, and its real merits possibly have yet to be ascertained. The écraseur consists of a strong steel chain, forming a loop at the end of two metal grooves, which is drawn tight by a wheel and axle, or other mechanical power employed with sufficient force to tear asunder by slow degrees any textures embraced within the circle of the loop. The force of the écraseur is such as to be irresistible to any structure of the human body, bone alone excepted ; and the advantages claimed for such an instrument are unquestionable, provided the morbid structure to be removed present the attributes suitable to the development of its peculiar powers. On such conditions, but on such only, the écraseur is an instrument of some utility, which may retain its place among the implements of the surgeon. When these conditions are neglected, its defects will so largely predominate over the merits of the instrument that it will be rejected as a coarse and mischievous appendage to the table of the

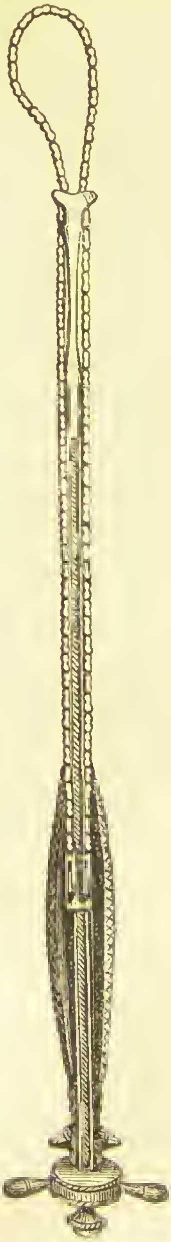


Fig. 16 (much reduced in size).

Professed merits.

operator. The écraseur professes to separate growths from the surface of the body, the removal of which by a cutting edge would probably be attended by objectionable bleeding. By such powerful constriction the integuments are drawn together at the point of junction of the tumour with that of the body, and thus the exposed surface left behind is reduced to an indefinitely small and almost nominal area, the healing process of which would be apparently perfected in the course of a few days. Such is the theory of the inventor.

The conditions required for exhibiting its powers consist in a growth, whether of skin or other morbid product, indicating probable loss of blood on removal by the knife, and attached to the body by a narrow neck. Without the liability to hæmorrhage, the offices of the écraseur are misapplied because the growth may be more readily removed by the knife. The merit of the écraseur consists in the exercise of a slowly applied crushing influence by which the blood-vessels are disorganised by severe pressure, and the textures brought within the chain-loop are compressed, blended, and rent asunder. On the first introduction of the instrument into this country certain rules were recommended for its employment, by which intervals of time were required or supposed to be required during its application for the coagulation of the blood within the vessels leading to the growth. But coagulation of the blood would appear to be by no means an indispensable condition to its use, because it is obvious that so great a degree of pressure is employed that the vessels are themselves disorganised in the general mass and their orifices blended with the tissue around. Escape of blood therefore is impossible, and although coagulation of the blood may not occur during the act of separating the tumour, it will doubtless quickly follow the operation. The second condition consists in the appropriate form of the structure to be removed. The circle which is to be subjected to the pressure of the chain, must be clear and definite. The line of junction of the tumour should be naturally constricted, because the chain involves in its pressure the textures on both sides, and this appears to me the most serious of the objections to the employment of the instrument—viz., its destructive influence on the parts around, for however complete the operation, however small may be the surface exposed on the separation

Real demerits.

of the growth, yet such is the fatal influence of the violence done to the parts around, that separation almost inevitably follows. I have at this moment three patients in St. Bartholomew's Hospital, from whom I have removed diseased growths by means of the écraseur, and in each case the exposed surface is at the present time greater than it would have been, had the operation been undertaken with the knife. From two of these persons I removed large hypertrophied growth from the prepuce.

Examples.

A weighty objection to the écraseur is founded on the fact that we cannot define the exact line of separation it may accomplish between the morbid and the healthy structure. The drag on both during the early part of the operation, or until the division is partly completed, is immense. The introduction of one or more needles can scarcely protect the tissues beyond them from being involved in the increasing force of the traction as the loop is reduced in size. The consequence is that when the operation is completed by the entire separation of the morbid mass, we find a want of nicety and exactness in the line which would have been more perfectly effected by the knife, and assuredly when the instrument is employed on a growth having no contracted neck, in other words when the substance included in the loop is large, the integuments around, when freed from the powerful agency by which they have been drawn together, will gradually retract and leave a larger surface exposed, which the immediate introduction of sutures will fail to maintain in apposition, by reason of the destructive power that has been exerted both on the integuments and on the textures beneath them. No doubt cases may be found, rare examples of disease whose form and nature may appeal to the écraseur as a warranted implement of surgery, but it will not frequently succeed in carrying out the intentions of the operating surgeon, if those intentions embrace a clean wound, limited in size, and of healthy character. The time consumed in the operation is longer than removal by other means, the pain without chloroform is great, and the principle as much allied to the period of barbaric surgery as any invention of the olden time.

Blunt-edged knives.

*Blunt-edged knives.*—I strongly recommend every young surgeon who professes the responsibility of operative surgery, to possess himself of a case of knives, the edges of which shall be just so obtuse as to render them incapable of dividing the external skin when drawn along it. The term "blunt" is of course relative. Its application to the instrument under consideration does not infer force of hand while wielding it. It infers the removal, by dissection, of slight cellular investments over blood-vessels or other structures,—and dissection among venous branches, not for the exclusive purpose of avoiding danger, to whatever degree such property may enhance the value of the instrument, but with the primary and paramount object of obtaining a clean exposure of a critical surface.

The fact of a wound caused by laceration pouring out less blood than one formed by incision by a sharp knife. has been long known to our profession. No sound reason can be suggested why this principle inherent in the structure of the arterial system should not be turned to advantage by the operating surgeon, whether for the exposure of large arteries, or the removal of tumours, or whether in hernia, the escape of blood is one of the chief obstacles to the progress of the operation. Then we resort to the blunted edge of the knife. When the flow of blood at the bottom of a deep wound is so great as to obstruct the progress of the operator, it ceases to be a mere inconvenience, and becomes a positive evil. Such amount of hæmorrhage may be avoided by the employment of a knife of a degree of acuteness as may be obtained by a silver blade, or by the ordinary steel blade being drawn once or twice lightly across a metallic surface. I was indebted to Sir B. Brodie, in the early part of my own career as an operator, for this very valuable suggestion; and I have no hesitation, after a moderately lengthened experience, in recommending the principle for general adoption. In my opinion, no prudent surgeon who is alive to the value of the circulating blood, will undertake some forms of operation without being armed with a case of silver knives, or without blunting the edge of a steel blade, should the occasion I have referred to occur. The difference in the effects of a sharp and a blunt knife is remarkable. From the moment of the application of the latter, blood ceases to flow, the wound continues dry, and the operation proceeds without interruption. By the well-timed employment of the blunt-

Advantages of.

edged-knife we avoid a possible danger, and an actual inconvenience.

*Ligatures.*—In intimate connection with the subject of instruments is that of the ligature.

Ligatures.

The experiments of Dr. Jones have long since proved that ligatures employed for tying arteries should be firm, round, and unyielding. They should be sufficiently strong to permit a force of tension requisite to cut through the two internal coats of the vessel, and something more; for as it is impossible to regulate with exactness the force of tension required, which is a little exceeded by the hand, so the ligature should possess such strength as will give confidence to the surgeon in applying it; but beyond this point strength is needless.

Strength of resistance.

The value of a ligature, therefore, is not enhanced by its power of resistance to our strongest efforts to break it, for such a force can answer no useful purpose when applying it around a wounded artery, where the sensation of the yielding of the coats is all that is wanted, and all effort beyond this, waste of power. Want of strength, whether of the hand or the ligature, may always be supplied by dexterity, on the principle that the shorter the part of the ligature between the fingers, the greater its resistance. The common material employed for ligatures is silk, formed into the thread of every variety of size and of twist. It is quite unimportant, however, what its composition, provided it possesses the above requisites, whether silk, flax, leather, catgut, or silkworm gut, for all these agents have been resorted to. Whichever be selected the ligature should be firm, well twisted, and waxed for the occasion. By some surgeons a fine flax thread known as the Glasgow twine is preferred, the resistance of which is certainly greater than silk in relation to its size. It is hardly necessary to say that the size and strength of the ligature should be proportionate to the size of the vessel to be tied.

Mode of applying.

In applying a ligature on a vessel, the thumb should be pressed downwards on the thread closely in contact with the artery, and as little more than the diameter of the vessel as possible should interpose between them. When the first half of the knot is tied, the act should be accompanied with a slight sawing motion, to insure the fullest degree of tension with the smallest degree of manual force. If the two thumbs brought into contact at the knuckles be applied on the thread close to the knot, and the above movement be adopted, the two internal coats will be divided with a very slight exertion of the hand. If it be intended to close the wound, one end of the ligature is cut close to the vessel, and the other drawn through the outer wound. If this attempt be hopeless, and the wound be left to granulate, the two ends may be cut close to the vessel.

Three conditions.

Ligatures are applied round arteries under three conditions: first, when the artery is exposed by the knife for the cure of aneurisms; secondly, when an artery is wounded in common with other soft parts around, as in punctured or lacerated wounds; thirdly, when it is entirely divided, as in amputation. In each of these forms of injury to the vessel a different process is adopted. In the first we apply the ligature around a healthy artery in a sound condition, and uninterrupted in its course; in the second, having exposed a wound in the artery, we apply a ligature both above and below it; in the third, we tie up its open mouth. In all these examples, when the artery is large, the division of the two internal coats is indispensable.

Sponges.

A single remark on the use and application of the sponge may not be deemed irrelevant to the objects of a work on operative surgery, and which I am the more disposed to make, because I have too frequently witnessed the misapplication of this necessary and most useful appendage to the operating table. The sponge should be soft for two reasons; first, because its application is required upon an exposed and sensitive surface of the body; and, secondly, because without being easily compressed by the hand, it cannot effect its object as an absorbent of the blood. The size of the pieces selected will depend on that of the wound, and, of course, on the quantity of blood to be absorbed by each application of the sponge to the surface. If the hæmorrhage be considerable, five or six pieces will be required, and they should be frequently changed, and freely washed in clean tepid water; otherwise they are liable to become sodden by the absorption of blood that coagulates in their interstices. The eye of the chief assistant, whose duty consists in managing the wound and in keeping it clean, should never be taken off it for a moment. The sponge should be applied to the bleeding surface quickly, pressed with some force upon it, and as quickly removed, in order that the operator may resume his work on a comparatively dry and clean surface. One additional hint I would venture to give, viz., that the office of a sponge is totally distinct from that of a towel, or even of a brush, and should not be employed to wipe or rub the structures exposed, unless for the purpose of removing coagulated blood, but should be simply pressed upon them, retained for an instant, and rapidly withdrawn.

# CHAPTER III.

FREEDOM IN HANDLING THE KNIFE — LENGTH OF INCISIONS — CLOSURE OF THE WOUND — HÆMORRHAGE, MODE OF ARRESTING — UNION OF OPPOSITE SURFACES — DIRECT ADHESION, ETC. — ADVANTAGES OF PRESSURE — SUTURES — QUILLED — UNINTERRUPTED — GLOVER'S — TWISTED — SHOTTED — PLASTER, MODE OF APPLYING — LACERATED WOUNDS—DRESSING OF WOUNDS—CHARCOAL AS A DISINFECTANT—ABSCESS—TETANUS.

Vertical direction of first incision.

All first incisions should be made vertical to the skin, and this will be effected by the hand being turned downwards in extreme pronation, while in the act of dividing. The objections to the neglect of this important rule, are, first, that supposing the incision be made on the face, for example, the after union of the edges of the wound will not perfectly correspond in thickness, and a broader cicatrix than necessary, will leave its permanent mark, probably for life. Secondly, that as the first incision may be supposed to have been accurately made, as regards the part to be exposed, which may be a deep-seated artery, the consequence will be, that the direction of the wound will carry the operator by the side of, and beyond the vessel, without exposing it; and this evil arises from the simple cause above mentioned, of dissecting downwards obliquely, instead of vertically. The process of exposing deep-seated parts, whether for their insulation and removal, or for the purpose of clearing away the cellular and fatty structures around an artery in a case of aneurism, is justly termed, a dissection of these parts. The manner in which this object is attained, bespeaks at once the experienced manipulator, whether possessing the experience of the dissecting-room, or solely that of the operating theatre.

Action of the practised operator.

The practised operator, familiar with the use of his knife, and confident in himself, divides boldly and freely: he makes his progress clearer at every incision; he prosecutes his work systematically, finishing whatever he begins, unless he has a good reason for the contrary; he operates slowly and steadily, but efficiently; every cut tells, every movement of his knife has a meaning and an object.*

On the other hand, timidity marks the ignorant man at every step. Uncertainty and indecision characterise his movements; he passes from one part of the wound to another, without any rational object or intention; dissecting a little here, and dividing a little there—completing nothing. Finding his own resources fail, he lends an ear to the suggestion of one assistant, then to that of another; and adopting imperfectly the advice of each, he protracts the operation to three or four times the period required for its performance, by a man of ordinary dexterity and knowledge; till, worn out with prolonged suffering, his exhausted patient is at length consigned to his bed.

**Length of incision.**

The precise line over which the first incision should be made being determined, the next consideration relates to the length of the incision. The reasons against a division of unnecessary length are obvious, while those urged against the opposite error are perhaps still more striking. It is a very important object in the accomplishment of a good operation, for the surgeon to clear his way as he proceeds, and to obtain space sufficient, both to view and to handle freely, the part either to be exposed, or to be removed.

**Necessity of obviating a contracted wound.**

It is a common fault of the unpractised operator to dissect the wound into the form of a cone, with its base directed upwards. This arises from his neglect in continuing the division of the structures within, to a length equal, or nearly equal, to the outer wound. Thus every successive stage contracts it in length, till he finally reaches a point from which he is compelled to retrace his steps, with a view to make a more perfect division at each extremity of the wound, up to the surface of the skin, consequent on the contracted space into which his dissection has unhappily led him. Care should be taken to avoid this error from the outset. In difficult and complicated operations for the removal of tumours in the neighbourhood of large vessels, such as the axilla, or the front surface of the thigh, the observance of this rule is of the utmost moment. The process should be one of dissection, in which the knife of the operator should be employed in clearing his way as he proceeds, by removing every obstacle from his path, completing each part of the work he has undertaken, before he advances to another. Let us suppose a large tumour to occupy the upper and inner region of the thigh, the nature, extent, and relations of which cannot be sufficiently ascertained, to enable the surgeon to determine on his exact course of action. The external incision should exceed the length of the tumour, by at least an inch or more in each direction. The fascia, when exposed, should be divided to the full extent of the outer wound. The disease is now found to be connected deeply, and covered not only by the sartorius muscle, but by the yet deeper adductors. The question then arises in the mind of the operator, how far it is necessary to divide the first of these muscles. This question would be solved by bending the leg, and drawing it inwards. If the muscle be now entirely relaxed, and be separated from its attachments, so as to enable the assistant to draw it aside with a blunt hook, it may be left untouched; otherwise it should be cut across, and its extremities at once dissected backwards, and turned off the tumour. This may become a necessary step in the progress of the operation, and is given as an example of that rule that requires all obstructions in the path of the operator to be removed as they appear. The same remarks will equally apply to the deeper muscles. It is almost unnecessary to add, that all structures exposed, that do not interfere with the progress of the operation, should be left untouched.

---

* Let it always be recollected that the hand is the index of the mind, and that it should invariably follow, not precede, its dictates.

If the outer incision be found of insufficient length—if its extent be such as to hamper the operator by requiring its extremities, or indeed any part of the wound, to be undermined, the effect of which will be, that one part only of the cavity can be brought into full view at one time; if it appear that the integuments must be drawn towards the part of the wound in which the operator is engaged, in order fully to expose the cavity; then it is obvious that the external opening is inconveniently small, and should be enlarged, either in the longitudinal direction, or by a cross incision, whichever

Enlarging the external wound.

may be found to free the surface of the diseased part the more effectually. There is less discredit in this after-division of the skin, and its adoption at any stage of the operation, than in persistence in the difficulty and danger of prolonged dissection in parts, not fairly exposed to the eye. Should increasing difficulties arise, such incisions may be resorted to, in any direction, and at any stage of an operation ; for it is less offensive to the true principles of operative surgery, that second external incisions be made, than that the first should be disproportionately long to the size of the tumour.

*The operation should be advanced by every movement of the knife.* The student of operative surgery should cultivate the practice of making a free division of the obstructing parts, such as the subjacent cellular tissue, fascia, and fat, &c. All that the knife can do with safety should be effected by each single movement of the hand, whether in the first incision, or in the after-dissection. In the operation for tying the femoral artery, the first incision may extend nearly downwards to the fascia. In lithotomy, the first incision may almost reach the groove in the staff, and the requisite depth of the remaining part of the wound, may be almost perfected: even in hernia, the skin and superficial fascia may be divided by the first sweep of the knife.

Necessity for the entire arrest of bleeding.

The second stage of the proceeding consists in preparing the wound for its final closure. But before this is undertaken, the surgeon will determine whether or not he make the attempt to heal the wound by the first intention, as it is called. If it appear to him expedient to do so, his attention must be directed to the bleeding surface, the whole of which should be fully exposed, the coagula removed, and bleeding encouraged by pressing, or even by gently wiping the suspected parts, and each vessel secured with a ligature. This stage of the operation should be effected deliberately and completely. It is difficult to insist too strongly on the importance of rendering the wound perfectly clean and free from blood, before its edges are brought into contact. Blood in almost any quantity may be considered in the relation of a foreign body, and its presence will most effectually preclude the chance of early union of the sides of the wound. By the aid either of pointed forceps, or of a tenaculum, or the instrument known under the name of Assalini's forceps, every bleeding vessel may be secured; but oozing of blood may still continue from large surfaces, in which neither the forceps nor the tenaculum is available. This oozing, though inconsiderable at the time, may become the focus of great after mischief. The influence of cold air, and the reduced power of the heart, may combine at the moment to arrest all bleeding; but the act of removing the patient from the operating table, the warmth of the bed, and the resuscitated power of the heart, all contribute, in the course of a short time, to promote a return of hæmorrhage, unless great care has been taken to prevent it; and even this will fail, if there be a tendency to bleed from minute vessels. When this oozing prevails in a positive degree, and when it would appear that every reasonable attempt has been made to tie all the smaller arteries without success, it is better to remove the patient to bed; to leave the wound open for some hours, exposed to the air. However desirable it may be to complete the operation in all its stages at one time, and before the patient has been removed from the operating table, yet the security afforded by this practice against the necessity of reopening the wound, an evil of great magnitude, more than counterbalances its objections. The direct exposure of a wound to the air, is, in my experience, by far the most efficient mode of meeting the difficulty. The application of sponges, flue of lint, pressure, all succumb to the persistent influence of cold air. The more strenuous our efforts to control the bleeding from minute vessels, by local styptics, the more inefficient do these agents become; while we may rely with confidence on assuming a bold front before the enemy, and giving it apparent encouragement by indifference.

Exposure of a bleeding wound to cold air.

If the source of the bleeding be concealed, the wound should be laid open, a stream of cold air be directed upon it from the lungs, or even from a pair of bellows, and the coagula left untouched. A few minutes' perseverance in these means will rarely fail in arresting any form or degree of hæmorrhage, arising from simple causes. In cases in which a patient is seriously exhausted, and whoso life is in immediate danger from loss of blood, or under circumstances of bleeding of a specific character, of course other agents, such as powerful and destructive escharotics, actual cautery, &c., must be resorted to.

Coagulum fatal to union.

If a wound contain a coagulum of blood between its walls, it will not heal. The edge of the wound may firmly unite in the course of thirty-six or forty-eight hours, and give promise of solid union; but its after separation, for the purpose of throwing off the contained coagulum, is inevitable. This can only be effected by a separation of the edges, by which its healing action becomes exhausted, and the hoped-for union by the "first intention" is superseded by the protracted process of healing by granulation and cicatrization. Thus the date of recovery from large wounds is postponed for many weeks. Some short time after my appointment to the office of assistant surgeon to St. Bartholomew's Hospital, I was called to a case of compound fracture of the leg, in which amputation was inevitable. I removed the leg, immediately below the knee. In reflecting the outer flap, I observed that about an inch of the subcutaneous cellular and adipose tissure were infiltrated with blood that had already coagulated. Not being alive to the evil of its presence, or the truth of the principle which I have above urged, I retained the integuments as a portion of the flap. In two days the wound appeared to have firmly united: within a week, the infiltrated integument had separated and sloughed. The end of the tibia became exposed, and the man was three months in the hospital.

Example.

The tendency to hæmorrhage is sometimes unusually great and protracted, as exemplified in the following case.

I removed a small tumour, of about the size of a pigeon's egg, from the lower part of the breast of a young lady. The parts were somewhat vascular and occasioned some trouble in arresting the bleeding. Having to leave town shortly after the operation, I took additional pains in effecting this, leaving the wound exposed to the air for at least half-an-hour: finding all bleeding to have ceased, I brought the edges together, and fixed them with suture and plaster. On my return to town the following day, I found the wound distended and hot, the hæmorrhage had returned, and the bed-clothes were saturated with blood. I imagine the lady must have lost at least twelve or fourteen ounces, although I had not had the opportunity of applying a single ligature. Many weeks elapsed before her entire recovery. Such are cases not of uncommon, but of frequent occurrence, and they are quoted for the purpose of impressing on the mind of the young surgeon the indispensability of checking all tendency to the escape of blood between the surfaces of wounds, destined to union by the first intention, before they are "put up."

This rule is imperative. It is of little moment whether a wound be closed at the time of the operation or at a period of some few hours afterwards. Such postponement will not interrupt the process of union by the first intention unless it be unnecessarily prolonged beyond the period at which all liability to hæmorrhage has ceased.

Precise contact of surfaces necessary to perfect union.

The blood having ceased to flow, and the displaced parts, if any, carefully readjusted, no further time need be lost in bringing together the opposite surfaces of the wound, with a view to their ultimate union. In order to carry into effect this object, *these surfaces must be brought into immediate and precise contact.* The adhesion of the edges of the wound, however desirable, is of little moment, when compared with the importance of direct apposition of one surface with the opposite. Suppuration of the interior of the wound is the certain result of neglect of this golden rule, and suppuration is fatal to union by the first intention. If the sides of the wound are not in apposition, we necessarily have a cavity between them; in other words, the surfaces are exposed to air; they inflame; an abscess follows; the united edges of the surface separate, and the whole wound becomes one large cavity, which eventually heals by granulations. No doubt, as argued by Mr. Paget, in his valuable College Lectures, in which he has quoted a case of mine to that effect, the edges of a wound may heal late by granulations, after being some days in contact, when no attempt at union is made by the simpler process of the "first intention." But this is to be regarded as an exception to the rule, and not the rule itself. Unless the edges of a wound unite with some degree of firmness within twenty-four hours, they will not generally unite at all; and for the same reason, if the edges, having united, are forced asunder by internal irritation, whether caused by the presence of coagula, or by the necessary escape of matter, the union of these edges by this process is completely at an end, and the wound gapes to its base. In operations

Union within twenty-four hours, or protracted for many days.

for the application of a ligature around a deep-seated artery, and similar operations, this liability does not exist, because, no material having been removed, the parts naturally resume their former relations; and if they do not, it is the duty of the surgeon to bring them into that condition. But in cases of removal by excision of large tumours, burrowing among deep-seated muscles, or under the scapula, in the ischio-rectal fossa, among the adductors of the thigh, a locality rather obnoxious to their growth, or under the superficial muscles of the calf, here the liability to a cavity is great; and the more especially so, when the opposite surfaces of the wound are composed of muscular structure, by the spasmodic action of which, the healing process may be supposed to be constantly interrupted, and the tendency to suppuration in an equal degree promoted. No effort should be spared to obviate this evil. If we fail to bring into the most exact apposition the opposite surfaces of the cavity, we insure suppuration, we destroy the only chance we possess of union by the first intention, and we indefinitely protract the recovery of our patient.

Adhesive plaster.

When the edges of a wound can be readily brought together without effort or stretching, *and are well supported by the parts underneath*, and the expanse of surface is considerable on both sides, such as occurs in wounds on the surface of the trunk, thigh, or neck, good adhesive plaster will render the resort to sutures unnecessary; but it must be good; it should be recently made, and, unless in cold weather, it should adhere to the surface without the application of heat. One broad strip should pass across the middle of the wound, and extend some inches beyond it, in each direction, care being taken on applying it, to adjust the edges of the wound together. The remaining strips may be narrower, unless the wound be a very large one; but it is better to leave two or three small intervals between the strips, for the oozing of blood, or other discharge. The wound should not be overloaded with plaster, which is required for no other purpose than that of keeping its edges in contact, and to this end, one thickness of good plaster will suffice.

It would be difficult to exaggerate the merits of pressure in the treatment of various kinds of wounds. Its efficacy is apparent under so great variety of conditions, that it is almost difficult to select a wound of any kind in which it is objectionable. But pressure is more especially required in all examples of wounds made by the knife of the operator in which there remains the smallest tendency to a cavity within. Such are the conditions following amputation of a limb; the excision of the breast under nearly all circumstances; the removal of tumours occupying the deeper textures of the body, and often of chronic abscesses pouring out matter in large quantities, and in various other conditions of disease. The primary object to be derived from pressure is that above stated, of obliterating the tendency to the formation of a cavity. The smallest defect in apposition of the opposing surfaces becomes the prelude to suppurative action, which will probably extend its influence around, and to this liability may be not unreasonably attributed many a protracted recovery from a very simple wound. The tendency to suppuration, and the inaptitude to assume the healing process, may be aggravated by the presence of air in the wound, which, becoming decomposed, may also contribute to its interruption. To what size a cavity within the solid structures of the body should be reduced to render it safe from suppurative action; or, on the other hand, to enable us to rely on its obliteration by the effusion of lymph, it is difficult to determine, but we know sufficient to assert that obliteration by pressure is our only protection against a process which must greatly prolong the period of recovery. One of the best media by which pressure can be effected is cotton wool, an agent very imperfectly represented by what is termed "wadding;" which consists of a coarse form of the cotton glazed and rendered firm for obtaining amplitude to a lady's dress. The cotton wool for surgical purposes should be fine in texture, white in colour, and perfectly free from the shreds of the husk of the pod. It may then be greatly commended for its softness, and especially for its elasticity; two properties which render it especially eligible as the medium of pressure. It is easily applied and as easily removed, unless it come into contact with a raw or exuding surface. In recommending the efficacy of pressure in the treatment of all wounds formed over cavities in the body, it is necessary to remind the young surgeon that the principle, excellent as it may be when employed with moderation, may be rendered injurious and defeat its own object when employed in excess. The living structures will recoil against such pressure as may injuriously retard circulation, or impair the natural sensibilities of the affected part by pressure on the nerves supplying it. There exists a rational medium at which a large wound may obtain by pressure a sufficient support, short of that degree by which either the circulating or the nervous systems of the part may be injuriously involved. Pressure is also a most valuable agent of good in promoting by its stimulating properties the absorption of fluids or even of solid structures of almost any morbid character. Its efficacy in effecting absorption of the infiltrated fluids of anasarca, and of solid œdema of the limbs, is well known, as well as that of fluids in chronic conditions of the joints, of hypertrophy of the skin, and of unhealthy granulations; and its influence has been called into requisition for some years past by Dr. Arnott, for the absorption of cancer in the breast and other morbid structures. It is difficult to imagine an agent more universal in its operation on the economy than that of well-applied pressure for the removal of morbid deposits and the promotion of healthy local actions.

**Sutures, when required.**

When the edges are brought together with an effort, and the surface below cannot afford an entire support to the flaps, as in amputations, we have recourse to sutures, as also when the flaps are very loose, and not easily adjusted to each other; sutures also are quite requisite where two or three flaps are brought to meet in a point. This we occasionally find in Taliacotian operations. After all operations, except those on the face, and the exposed parts of the neck and chest in women, the bringing into a general contact of the opposite surfaces is all that is required. Of the above exceptions I shall speak more at length hereafter.

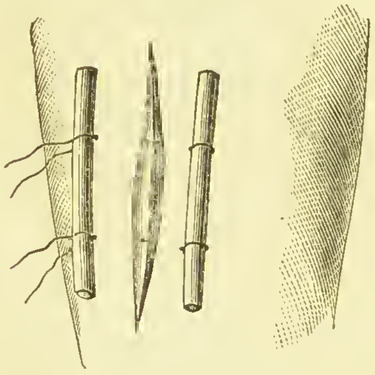
In wounds of the trunk and limbs, and also in amputations, two or three sutures are sufficient; the intervals may be two inches or more in length, and these intervals should be occupied by plaster. The precision and exactness of the union, and the breadth of the cicatrix, is comparatively of little moment, and yet some care should be bestowed that the apposition of the two surfaces be tolerably perfect. The only excuse for negligence in carefully adapting the two surfaces together, is obtained from the fact of the time that will be occupied in healing the wound, even under favourable circumstances, which the partial healing by granulations on the surface will but slightly prolong.

Varieties of sutures.

There are various forms of sutures employed in surgery. The office of a suture is that of insuring and maintaining a perfect contact of two opposing edges. The form of suture employed, will, however, depend on the nature of the edges, the depth of the wound, &c.; for, as has been already observed, it is needless to attempt the approximation of the upper edges of a wound, unless the deeper parts and base are also retained in precise contact.

Quilled suture.

The "quilled suture" is an old invention, and consists of the introduction of two or more threads through a wound at some distance below its surface; the threads being tied around quills or other material at a distance from the edges, the surfaces drawn into contact, and the cavity obliterated. But it is an inefficient antidote to the existence of a cavity, unless it implicate the entire surface. The object will be yet more efficiently attained by the force of external pressure, carefully applied to the skin at a distance beyond the wound. The immediate agent employed, is either soft folded lint, or what is termed by the French school, *charpée,* or masses of soft cotton wool. The pressure should be large and wide, not necessarily limited to the size of the cavity, but extending beyond it, on all sides.



Value of external pressure.

Uninterrupted suture.

"The uninterrupted suture" is applied by uninterrupted sewing, one continuous thread being passed through the opposite edges of the wound, and drawn tight. It is a coarse and painful agent, and possesses this decided objection, that when divided, the whole becomes loose, and is no longer serviceable in any part. The common, or interrupted suture, is a great improvement upon it, because the degree of tension of each part can be regulated, or partially removed at will. The necessity of watching each part of a wound, in the progress of union, renders it very necessary that we retain full command of the individual sutures, some of which may require early, others later, removal. This important object is precluded by the use of the "uninterrupted suture," which is rarely resorted to in the practice of eminent men, whether in England or on the Continent. It is, however, occasionally employed in wounds of the intestines. In the common or interrupted suture, the thickness of the thread employed is determined by that of the substance intended to be brought into contact, and the force requisite to effect this object. We cannot rely on the efficiency of a fine thread if force be required, because the thread would cut itself out by absorption, and the employment of a coarse thread would be equally ill-selected for a small wound, requiring an exact contact. It appears to me unnecessary to dwell on this subject, or to attempt to lay down any precise rule. I content myself with enforcing the principle, that the opposite surfaces of a wound must be brought into absolute contact, and that we cannot safely rely on the aid of any, but a thick suture, for a deep wound, by which the edges are well supported, and which suture would be most unsuitable to a wound through the skin, requiring a neat and perfect adjustment.

**Interrupted suture.**

**The glover's suture.**

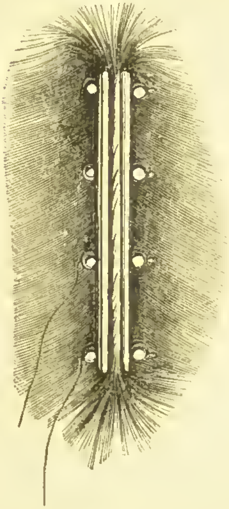
The "glover's suture" corresponds to that form of stitch employed by sempstresses, which is termed "herring-bone." It is rarely or never employed on the living body, being reserved exclusively for the arcana of the dead-house, where it is highly serviceable, and from which we obtain no testimony to objections that might otherwise be urged against it.

**Twisted suture.**

The form of suture commonly employed in hare-lip is called the "twisted suture," and is a modification of the quilled suture of the old school of surgery. It consists of one or more pins which are introduced across the fissure in the lip, around which is twisted strong silk in the figure of 8. It has this advantage over the quilled suture, that it substitutes a firm and solid material for a soft one, it diffuses over a larger surface the force which retains the edges in apposition, and at the same time it insures the more exact adaptation of the sides of the outer wound. This additional force is desirable, inasmuch as we have to contend in hare-lip against the tendency to separation caused by the action of the orbicularis muscle.

Shotted suture.

The "shotted suture" is a modification of the quilled suture, differing from it only in the nature of the material employed. Two, three, or more pieces of fine silver wire are passed across any deep wound at equal distances from each other, by means of a slightly curved needle. The two extremities of each wire are passed through a small hole drilled in a bar of plated metal, the length of which should exceed that of the wound. The wires are first fixed beyond the bar on one side of the wound, by means of perforated shot, about two of which may be strung on each wire, and compressed by means of a pair of pliers. The opposite end of each wire being now strung with perforated shot, the wound is drawn together, the shot pushed up to the bar and compressed, as on the other side. The superfluous wire may be cut off with the cutting-pliers. The shotted suture is a very clean and neat method of adjusting the two opposite surfaces of a wound. It is a manifest improvement upon the old quilled suture, but the principle of its application is the same.



I know no objection, commensurate with their value, to the application of sutures, in any part of the body, whether on the head, trunk, or limbs, nor to their including any structure, whether cutaneous, cellular, fibrous, or even muscular. They are certainly of little value when employed to retain in apposition a *transverse* cut through a muscle, unless the muscle be thoroughly relaxed. I am aware that some eminent members of our profession entertain an objection to the application of sutures on the scalp, and, perhaps, it is fortunate that the nature of the wounds in the region is such, as to enable us to resort to the use of plaster with equal advantage. I cannot say that my experience justifies this apprehension. I have repeatedly employed them in every form of scalp wound.

Wounds on the face re-

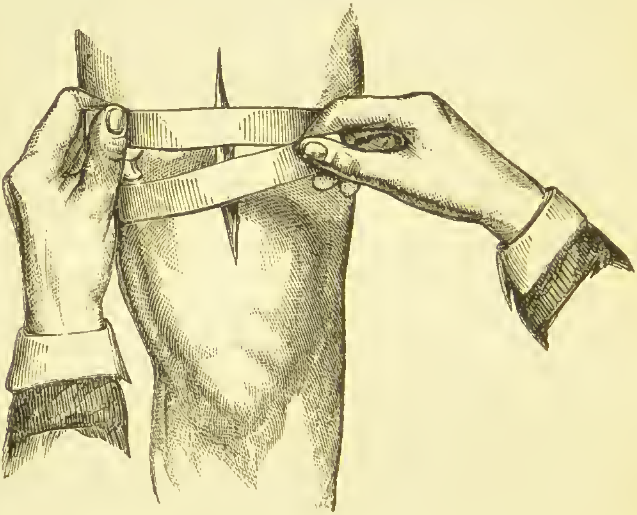
Wounds on the face, in both sexes, or on the neck or upper part of the chest, in women, require more consideration. The duty of the surgeon consists in exercising his best art, in concealing deformity; and it should not be forgotten, that in the face, the seat of expression, the slightest defect or deformity becomes apparent to common observation. It is within the range of our art to unite a small wound with such precision as to escape detection; but the manipulation must be perfect, and the care, the greatest that can be bestowed upon the case.

quire exact adaptation.

Sutures on the face.

Young persons, some years under puberty, possess this advantage, that scars from wounds occasionally wear away, and at sixteen or seventeen years of age they are often obliterated. Many years ago, a young girl was brought into St. Bartholomew's Hospital, who had been bitten by a dog about the face, neck, and extremities. The dog, in full conclave of the medical staff, was deemed rabid, and the parts were all excised, partly by the late Mr. Earle, and partly by myself. Each wound was carefully dressed. The girl recovered, and became a nurse in the ward. Five years afterwards I examined her, and not a vestige of her wounds was apparent. If a scar be left on the face consequent on an operation, or on the surgical management of any clean wound, the blame will generally, and often justly, rest on the surgeon. The wound should be carefully freed from its blood, and rendered perfectly dry. The edges should then be brought in *exact* contact, if necessary, by the finest suture. This necessity will depend on the form of the wound, as well as on its situation; for if in the angle of the nose, or in the immediate neighbourhood of the mouth or eyelid, the efficient application of plaster will be made with difficulty. I employ, both in ordinary and in Taliacotian operations, the finest needle slightly curved at the point, with silk thread to correspond; of these, two or three may be introduced, or even more, should the length of the wound justify it. The puncture with the needle should be made at not more than a line's breadth from the edge of the wound, brought out in the wound, and again introduced, its point finally appearing at the same distance on the opposite side. All, or several of the sutures should be passed through the wound *before any of them are tied.* But intervals may yet remain between the threads, and, as before on the larger scale, so these intervals should be occupied by narrow strips of plaster, of which the best common adhesive plaster of our hospitals is preferable to any. Mr. Liston had a great predilection for isinglass plaster, but, in my opinion, it has positive demerits. It fails in giving the support obtained from the common adhesive plaster spread on linen. It certainly presents a very clean appearance, but it is required to be fresh when used, for the important purpose of retaining together large surfaces, and is comparatively expensive for any other. I can purchase no plaster superior to that used in St. Bartholomew's Hospital. Of such plaster two narrow strips should be cut, and warmed, if necessary, and each should be applied, by one half of its length, to the opposite surfaces of the wound. When thoroughly adherent, the other ends of each strip should be drawn simultaneously, but slowly, across the fissure, and as soon as the edges are brought into perfect contact, and *even drawn closely and pressed together*, the plaster should be fixed on the skin beyond, and the object of perfect apposition is attained. There is no reason why this mode of applying the strips of plaster should not be adopted on all occasions, in which it is desirable to effect an exact apposition.

Mode of applying plaster.



A yet more ingenious method of bringing the two opposite sides of a wound into exact adaptation, is one adopted by my son at St. Bartholomew's Hospital, and which consists in the simultaneous application of two strips of plaster in a straight line across it. This is effected by passing one strip through a fissure cut in the other. In the diagrams the two strips are represented with the adhesive surfaces directed towards the eye. In fig. 1 an incision is made in the form indicated. The two longitudinal flaps thus formed are now doubled backwards, and made to adhere to the surfaces on which they fall. In fig. 2 the plaster is divided by four small incisions made from the margins inwards. The two flaps resulting are folded inwards, giving to the centre a narrow tongue of three thicknesses. By this arrangement, the linen or inadherent side of each strip will be presented to the surface immediately over the wound. If one end of each strip be now applied on the opposite sides of the wound, and the portion corresponding to fig. 2 be passed through the fissure in fig. 1, the two edges of the wound may be very accurately adapted to each other. The exactness of apposition will be rendered apparent to the eye if the tongue of one strip be formed somewhat less broad than the opening through which it passes. The two hands are now employed in the same action, and with equal force in drawing the edges of the wound together.

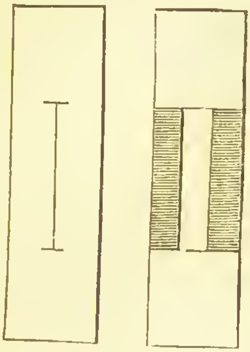


Fig. 1.

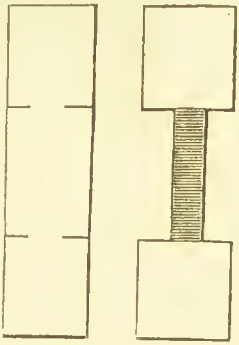
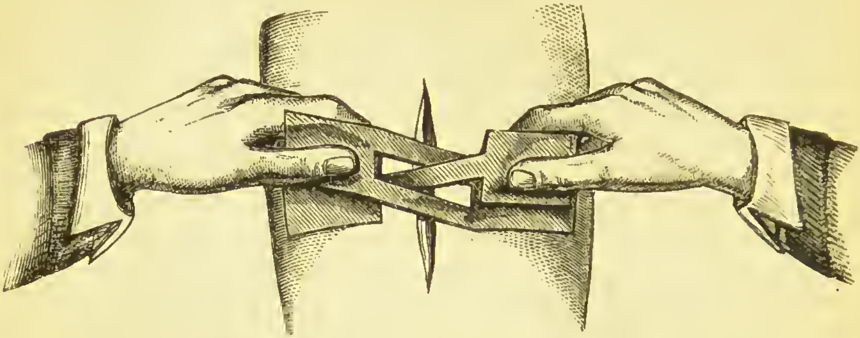


Fig. 2.

With a view to prevent the irritation of plaster or its adhesion to the fine hair on the skin on or about the margins of a wound, my house-surgeon is in the habit of applying some cotton wool to the plaster, which being detached, leaves sufficient wool adherent to the plaster, to destroy its adhesive power when applied on the skin.

This union of the opposite sides of the wound will leave little or no cicatrix, if it progress favourably. The principle of this junction of two living surfaces is distinct from that of the "first intention," which is effected by



the organisation of interposed lymph, poured out by the vessels of each surface, for the express purpose of filling an interspace. Here there is no interspace, but vessels simply shoot across, and unite the two into one. The union by the first intention is indirect; this is immediate, being perfected in the course of twelve or eighteen hours. This process was first described by Mr. Paget, and to it he applies the term "primary adhesion."* I had often suspected this mode of healing, though I had never verified the fact, for it would seem impossible that lymph could be poured out between two surfaces forcibly brought into perfect apposition with each other.

Union by primary adhesion.

It is to be regretted that we have it not in our power more frequently to avail ourselves of this valuable principle, in the *vis medicatrix;* but there is no reason why we should not make the attempt, and from which no evil can, and much benefit may, arise. Taliacotian operations, for obvious reasons, require the exercise of peculiar care and precision in the adjustment of their opposite surfaces, the further reference to which will be considered more at length under that subject.

Lacerated wounds.

I have hitherto confined myself to remarks on the subject of clean wounds made with the knife; but a different proceeding is often required in lacerated wounds, especially on the face, where it is obviously so necessary to make the attempt to restore the injured surface, as much as possible, to its natural appearance. The edges of such a wound, caused by violence, may be more or less jagged and irregular. In non-exposed parts of the body, the nature of the union leaving, as it necessarily will do, a broad and irregular cicatrix, is comparatively of no moment, provided it be completed; but when occurring on the face, it demands more attention, and every means should be resorted to, with the consent of the patient, or the parents, if in the case of a child, to unite the wound so effectually as to prevent the deformity of a future scar. The resources of operative surgery may very properly be resorted to in converting the ragged, into a clean edge, which shall be made perfectly to correspond with the opposite one.

---

* See College Lectures, by James Paget, for 1849.

Mark of cicatrix to be avoided if possible.

The union of two ragged edges of a wound, however perfectly effected by the first intention, will leave a scar by which the features of an otherwise beautiful face may be deformed for life.* It is the duty of the surgeon to endeavour to prevent this evil, by assimilating the wound as much as possible, to that made by a clean cutting edge. To accomplish this a portion of the skin should be sacrificed. As much should be cut away with a sharp knife as will get rid of the entire ragged portion of the wound, and continued until the opposite edges be capable of being brought into perfect contact. The same necessity would apply to wounds infiltrated with dust, or dirt, or fine gravel, the presence of which would preclude the chance of union, either by primary adhesion, or by the first intention. All the integument so involved, should be carefully removed with the knife or scissors; almost however large the portion, for otherwise it will probably slough. If the dirt can be dissected from off the inner surface of the skin, leaving the latter still forming its continuous surface with the surrounding integuments, it will be a great point gained; but in the form of injury alluded to, the entire skin is generally more or less involved throughout its substance. If so large a portion of skin has been removed, as to render the approximation of the two surfaces difficult, if after the introduction of a suture, (for the use of the forceps for such

Wounds infiltrated with dirt.

---

* Some schemes have been devised for the subsequent removal of cicatrices—such as blistering the surface. I have no faith in any of them.

a purpose is inadmissible,) a space remains between them, the two surfaces should be separated with a fine knife from the subcutaneous tissue, and converted into flaps, the extensibility of which will readily admit of their being brought into contact. The wound should be carefully cleaned, and the edges united by one, two, or three fine sutures, and their interstices occupied by yet finer silk, passed through with a needle not larger than the finest sewing needle, and somewhat curved at the point. The former may include the entire substance of the integuments, while the latter, involving a depth of less than a line, should unite the opposite sides in the proportion of about four, five, or even six, to every inch.

Integuments disorganised.

Lacerated wounds are often attended by extensive separation of the integuments, or the integument itself may be involved in the laceration, forming a large flap infiltrated with dirt, and extensively separated from the surrounding skin. The question arises, what should be done with a flap so circumstanced? Should it be entirely removed, or an attempt made to retain it? If it be disorganised, or nearly so; if the subjacent substance be also injured, and if the flap be nearly insulated, it should be removed, and the surrounding integuments brought forward by every means, to supply its place; for it is better to remove integument that will in all probability die, than to leave it to slough. As a general principle, however, the integument is too valuable a structure in the economy to be disposed of, without good and sufficient reason, and, with the above exception, it should be invariably retained; for, although a portion may slough, the vitality of the remainder will form a natural investment to the living parts beneath, and greatly abridge the duration of the healing process. Great care should be taken in effecting the closest apposition between it, and the structures beneath and around, and this is to be obtained by applying over the surface a quantity of soft lint, cotton wool, or other material, rolling the part pretty firmly with a calico roller, and uniting the flap as generally as possible with the healthy integument around, by means of sutures.

Dressing of wounds after operations.

The after-dressing of a wound resulting from a capital operation, is a subject of no slight importance to the issue of the case, and proportionate skill and care should be bestowed upon it. It is presumed that every requisite attention has been paid to the comfort of the patient, both mentally and bodily, and that every source of irritation has been carefully avoided. As rest and perfect quietude are so indispensable to the healing process, some attention should be bestowed on the position of the patient while in bed; the position being selected in reference not only to the comfort of the patient, but also to the necessities of the surgeon in dressing the wound. The first question relates to time; under usual circumstances, of large wounds especially, as after amputation, two entire days may be allowed for union, before the wound is exposed; but although this rule may be generally resorted to as a safe guide, yet it is subject to modifications from sundry causes, of which the following are among the most prominent:—1st. Distension of the wound from hæmorrhage during the first six hours, after the patient has been placed in bed; or indeed discomfort from any local cause. 2nd. Fœtor perceptible through the dressings, a not infrequent indication during the height of summer. 3rd. The great probability that the process of healing by direct adhesion has failed, often indicated by a tinge of redness on the edges of those parts of the wound readily exposed to the eye. Either of the above conditions justify dressing as early as the thirty-sixth hour, or even earlier, but as a general rule, forty-eight to seventy-two hours may be allowed to pass with safety, and in some cases, such as hare lip or fissured palate, from four to ten days, or longer.

Great care required in dressing wounds.

For this secondary operation, every preparation should be carefully made, and the most delicate manipulation employed by the surgeon. A good light should be insured, sponges, hot and cold water, plaster, already cut into strips, everything should be in a state of preparation as exact, as though required for the operation itself. The wound should be partially exposed by the gradual removal of the old strips, to be effected by raising each end from the skin, towards the centre, in order to prevent separation of any portion of the uniting wound by drawing it asunder, and detaching the new adhesion. If the old plaster adhere to the fine hair of the skin, it should be detached slowly by pressing the finger close along the line of its separation, and rather by pressing the skin from the plaster, than by drawing the plaster from the skin. It is advisable to shave the fine hair thus involved, or to cover it permanently with plaster, at the time of the operation. As soon as a strip of the first plaster is removed, the surface should be washed, or rather bathed with tepid water, and a fresh strip applied, either in one breadth, or divided into two, and simultaneously applied in the manner already described. This will depend on the degree of *dragging* to which the wound is liable from position or other causes. Other portions of plaster may then be successively removed, and fresh plaster applied as before.

Having alternately exposed piecemeal the entire surface, we shall be able to form a tolerably correct opinion as to its internal state, and to determine how far we can rely on the hope of union by the first intention. If its edges are pale, and not marked by a blush of congestion, if the wound be free from pain, and dry, and not distended, and the margins do not separate and retract on removing the plaster, an important step towards its recovery has been taken, and the critical stage is passed. But if the converse of these conditions hold,—if sanious fluid oozes from the cavity,—if the margins be discoloured with a tinge of congested vessels, and separate on carefully removing their support,—if the lead contained in the plaster be acted on by the sulphuretted hydrogen evolved from the wound, we have then too much reason to infer that the process of union has been arrested, or at best but partially effected. By this knowledge, which may always be attained with some certainty, the new dressing should be greatly modified. If, at the expiration of thirty-six or forty-eight hours, the wound present the characters above described, it is obvious that we cannot hope for early union, and certainly not for union by the first intention. Under these circumstances, the sutures should be removed, and the wound thoroughly cleaned by means of a current of warm water repeatedly squeezed from a sponge. Great care should be taken throughout the dressing to maintain whatever union has been effected, by retaining one or more pieces of plaster upon it.

**Supposed influence of sutures.** I have often heard the above congestion of the surrounding skin referred to the presence of the sutures. I greatly doubt the soundness of the inference. The redness of the skin is simply an indication of what is passing in the wound; for when the wound is shallow, or not very extensive, we do not so frequently observe that symptom, which is common enough in amputations, or in wounds made for the removal of large tumors. Moreover, we usually find the absence of union over the almost entire surface in such cases, which, if dependent on the sutures, would have failed to unite at the surface only. The sutures should be removed, the rather that they are no longer available to any useful purpose, and they may, and probably will, aggravate the evil already commenced. In this condition it is useless to attempt to bring the sides together with any hope beyond that of preventing further separation. The plaster becomes therefore a passive rather than an active agent, and its application may be limited to the extremities of the wound, the interval being occupied with water-dressing, or a light poultice of linseed, with which chlorinated lime may be combined if the edges of the wound show any tendency to slough, and the fœtor be positive. After the first dressing, whatever its condition, the wound will require its repetition daily. Daily dressing.

Poultices. One of the most remarkable relics of the barbarous surgery of the past age is the universal employment of poultices, whether of bread or linseed meal. Indiscriminately used to all surfaces, whether exposed or otherwise, I believe there exists a formidable balance against them; but when carefully made and employed with discrimination, they are not without their advantages. What application could be selected productive of more discomfort to a wound than a large thick mass of half-dried linseed meal of the weight of from one to two pounds, and this upon an exposed and sensitive surface; or similar masses of half-crumbled bread, which latter, employed on the surface of the person of a child, or even on that of an adult, almost invariably produces pustular eruption?

Poultices are objectionable on exposed surfaces, and more especially when applied thick. They were most properly denounced by the late Mr. Liston, and exploded from his treatment; and yet, when well timed, and well made, no kind of application is more suitable. Their employment should be restricted to the outer skin. They should be made light, smoothly spread, and if a small quantity of any simple unctuous substance, such as oil or lard, be combined with them, no material is more efficacious in maintaining an uniformity of temperature of the surface, or is more cleanly in its operation, than a linseed poultice. But they are often unsuitable to a raw surface, or even to a raw edge. As a dressing to an ulcer, or to most forms of open wounds, they are less efficacious than the water-dressing, made by the application of wet lint or linen, the moisture of which is retained by a covering of oiled silk. They are inferior to raw cotton as a dressing in small or large sloughs, such as those occurring in bed-ridden people. But as an application to an advancing or a discharging abscess, or to a painful joint, as employed by Mr. Abernethy, they have, in my opinion, no superior. The idea formerly prevailing, that they possessed stimulating properties, and the vulgar notion, that they exert a drawing power employed for the purpose of bringing a foreign body to the surface, is long since exploded by all reflecting men.

When applicable.

In cases of fœtid wounds, we occasionally resort to the addition of carbonaceous matter; such as powdered charcoal, combined with bread crumb or yeast, carrot, &c.

In all fœtid sores the employment of powdered charcoal is valuable as a disinfecting agent. Principally to the investigations of Dr. John Stenhouse, we owe the knowledge of the fact that under certain circumstances charcoal possesses the property of largely and greedily absorbing various gases, whether offensive to our senses or otherwise, and of effecting their rapid and complete oxydation.

Numerous and satisfactory experiments have demonstrated the practical utility of charcoal when applied to these purposes. Charcoal has long been applied for the purpose of purifying water by means of a filterer, and it is equally applicable to the purification of common air when filtered through it. The properties of the charcoal are permanent and may serve the office of a purifier for any reasonable length of time, provided it be heated occasionally in order to dispel the gases with which it may have become saturated. This important property of so readily attainable an agent as powdered charcoal merits universal recognition, and it should be freely resorted to in all examples of fœtid sores both for the benefit of the patient and his attendants. The charcoal may be applied by means of gauze bags of three or four inches in diameter, and lightly filled with the powder. Two or more of which may be hung about the cradle placed over the sore. It may also, as established by old custom, be applied in poultices or other various forms of local applications whenever the sore assumes a fœtid character.

Punctures and incisions for evacuating the contents of an abscess.

When an abscess under the skin has reached its period of maturity, the matter should ordinarily be evacuated, either by puncture or by incision. The selection of the one or the other of these two modes will depend on the size of the abscess, on its degree of maturity, and on the constitution of the patient. The difference between the two modes of operating consists, in the first, that of withdrawing the instrument employed through the orifice by which it was inserted; and, in the second, that of enlarging the wound beyond the breadth of the instrument, by incising the wall of the abscess to a greater or less extent. If the abscess be large, it is highly probable that the process of suppuration will continue after the matter has been removed; therefore, it is not expedient to rely on a mere puncture, unless with a very broad instrument, lest the outer wound close, and a second opening become necessary. If, in the case of abscesses of a chronic form, the incision should be only sufficiently large to permit the contents to pass through, where we can entertain a reasonable hope that the cavity will become obliterated. More generally, however, the abscess continues to discharge more or less copiously, and under these circumstances the incision should be large and the wound left open, a large fold of lint being applied and carried to the bottom of the cavity.

Exact period for puncturing an abscess.

In every common phlegmonous abscess of the subcutaneous tissue, there exists a stage of progress towards its consummation, a stage of maturity, and a stage of absorption of the material composing the walls of the abscess next the skin. If the matter be evacuated during the first stage, the suppurative action is not exhausted, the outer wound will readily heal, and the suppurative process will continue uninterrupted. The period of maturity of the abscess is, by this untimely operation, postponed probably for some days, in consequence of the cyst having been partially relieved of its contents. This is the general history of small abscesses, which, having been ineffectually punctured by patients themselves, and relieved for the moment, regain their former energy, and ultimately demand the aid of the surgeon for their permanent cure.

The third stage is characterised by thinning of the cutaneous wall, which, congested with blood, becomes every day less amenable to the healing process, and if the abscess has long passed its period of maturity, the integument when divided will shrink, or become absorbed, and an ulcer will succeed. This also is the history of the frequent extensive ulcerations in the groin, found in the venereal wards of our hospitals, in which either the abscess has been brought to a crisis at too late a stage for the recovery of the integuments, or has been allowed to burst through the attenuated skin, without the aid of the knife. In this latter stage, an incision, large in proportion to the size of the abscess, should be made along its long axis. Of late years the vertical direction is recommended for division of abscesses in the groin, although the axis be transverse. This practice is, I believe, universally adopted by Mr. Lawrence.

The second stage occupies but a brief interval, and is characterised by severe pain, fullness and discoloration of the skin increasing up to the centre. If the health be vigorous, and the constitution sound, and the precise day or even hour well selected, a simple puncture, that will permit the escape of its entire contents, will generally suffice for the cure. For a mere puncture, a large common lancet may be employed; for an incision, which is much more frequently required, either a fine straight knife, or an abscess-lancet is preferable. The point of the instrument should be introduced at half the length of the projected incision from the centre, and carried rapidly across to a corresponding point on the opposite side. Yet I think I have observed that the rapidly executed division of inflamed and very susceptible skin creates more severe and protracted suffering, than when executed with more deliberation. When the wound is small, it is generally desirable to introduce a few threads of lint into the cavity, to prevent its union by the first intention, and by which a second operation may be rendered necessary. Collections of matter occurring in weakened constitutions should be generally opened early, to prevent the abscess degenerating into an ulcer, the frequent consequence of thinning of the entire cutaneous wall from the absence of sufficient power to make it point.

Tetanus.

Connected also with the subject of wounds, and incidental to the occurrence of local injury, whether the result of accident or of surgical operation, is that of tetanus. Tetanus is an affection of the nervous system, in which the muscular frame becomes the seat, first of spasm, and, secondly, of permanent and painful contraction. This horrible disease manifests itself by a sense of stiffness in the muscles of the jaw, which is occasionally mistaken for rheumatism. As it advances, the muscles of the back of the neck, back, chest, abdomen, and, finally, the extremities, become involved in one universal cramp. Each muscle is raised into a hard, rigid swelling; fixing the body immoveably, and producing excruciating pain. Hour after hour but adds to the extent of the parts involved, and to the intensity of the disease, till death puts an end to the patient's suffering. This crisis occurs on, or about, the third or fourth day from its first appearance. In some cases, and not the least severe, the spasm is nearly confined to the head and trunk, the extremities being left tolerably free.

Occasionally we find strange and unaccountable remissions of the symptoms; and patients have been known to rise up from bed, believing the disease to have left them. But it is rarely that tetanus ends but with the death of the affected person; though, like some other affections of the nervous system, a temporary but most deceptive lull of all the symptoms, is followed by their sudden recurrence, and death ends the struggle.

Inefficiency of remedies commonly employed.

Every remedy that ingenuity could devise has been more or less fruitlessly applied to arrest the progress of this fatal malady. Depletives of all kinds, purgatives, narcotics, antispasmodics, sedatives, counter-irritants, all have failed. Here and there a case of partial success, and even of complete recovery, gives a temporary eclat to a new remedy. Of all these agents, perhaps opium is the best, but it must be administered freely, and without fear. The largest doses alone afford any chance of benefit. To trace the already well-trodden ground of past experiment,

Case.

Opium.

Chloroform.

is to trifle with human life, and to exhibit a pusillanimity of conduct unworthy a profession that daily enters into the contest with death. Better that the patient die under opium, than under tetanus. I have recently witnessed the dying pangs of a fine young officer, who, in taking a loaded horse-pistol from his carpet-bag, accidentally struck the trigger, and the ball passed through his hand. I removed the third finger and metacarpal bone. The wound progressed well, and was rapidly healing with florid and healthy granulations, when, as late as the twelfth day, tetanus appeared, with spasm occurring about every minute, in the right serratus magnus muscle, and pain around the origin of the diaphragm. The disease had existed, though slightly, for twenty-four hours, when I was called to him. In conjunction with Mr. Lobb, I ordered him forty drops of laudanum every two hours, and the pain remitted. In six hours it returned with more violence in the same regions. His pulse was 130 ; his countenance betokened intense suffering; his breathing was rapid, and he sweated profusely. I ordered him chloroform occasionally through the night. This agent was administered twice, and each time with great temporary relief. On the following morning, he was yet more suffering; pulse 140 ; jaw fixed, but not closed. Intense pain in the chest and back of the neck. I administered chloroform, and requested it might be used continuously till the hour of our next visit. The instant he was brought under its influence, *he sank back into a tranquil sleep, and his pulse and breathing fell to their natural standard.* He appeared perfectly free from disease. In this condition, constantly plied with chloroform, he remained, without the intermission of a moment's suffering, for six hours and a half. The instant he awoke, the enemy was at hand, and he screamed with agony. He had an enema of turpentine, and his back was blistered. At the imprudent request of an attendant, he put out his tongue, and the jaw closed upon it, and would have severed it in two, but for our assistance in wedging the teeth asunder with the handle of a spoon, the first instrument at hand. His death was now certain, and I resolved he should die under chloroform, which was again administered for thirteen hours without remission! The drug then failed us; he became so tolerant of its action, or, perhaps, his sufferings were so great, that the pains gained the ascendant, and he died in torture in forty-two hours.

In this case, I think I may be said to have fairly tested the merit of anæsthetic agents, which are invaluable in their power to arrest suffering, but possess not the slightest power in contending against the disease itself. Should another case occur to me, I should be disposed to apply the actual cautery freely under chloroform, along two-thirds of the length of the spine. I had no hope of benefit from amputation of the arm. The question might have been raised had I seen this patient at the date of the first symptoms, which advanced very slowly for the first thirty-six hours. Of one thing I feel very certain, that the administration of any agent that promotes weakness, ministers to the disease.

# CHAPTER IV.

## ON DISLOCATIONS.

OBJECTIONABLE NOMENCLATURE EMPLOYED IN REFERENCE TO DISLOCATIONS — PRINCIPLES OF REDUCTION — INFLUENCE OF MUSCLES IN PREVENTING REDUCTION — INFLUENCE OF MUSCLES IN EFFECTING REDUCTION — COMPLETE AND PARTIAL DISLOCATIONS — EARLY REDUCTION MOST READILY EFFECTED—PERIOD AT WHICH REDUCTION MAY BE ATTEMPTED IN OLD DISLOCATIONS: 1. INORGANIC CONTRACTION OF MUSCLES; 2. FIBROUS ADHESIONS; 3. FIBROUS SUBSTANCE OCCUPYING SOCKET—GRADUAL EXTENSION—APPLICATION OF AGENTS OF EXTENSION — OBJECTIONS TO APPLICATION OF EXTENDING FORCE TO THE DISLOCATED BONE — EVIDENCE OF REDUCTION—SPECIAL DISLOCATIONS—DISLOCATION WITH FRACTURE.

Nomenclature bad.

By the term dislocation, is understood a displacement by violence of any part of the osseous components of a joint from the remainder. The word, however, is illogically, but too frequently applied to the joint itself, and the only justification of its use, would be a displacement of the entire joint in relation to the rest of the skeleton. Thus we speak of dislocation of the ancle, instead of that of the foot; dislocation of the elbow, instead of that of the ulna or radius. The shoulder-joint, for example, is composed of the humerus and scapula. If we employ the term "dislocation of the shoulder," we *should* mean dislocation of both bones from the chest, but we *do* intend to express simple displacement of the humerus from the scapula. The objections to this false nomenclature are greater than the nature and objects of this work admit of the further exposition. A joint is the seat of dislocation, when any of its bones are separated from the rest by displacement; and, looking alone to the cause of the injury thus sustained, we are justified in applying the term dislocation to the bone only that is displaced, viz., that which is the more remote from the trunk. Dislocation of the foot is the result of violence directed against the foot itself, and not against the leg. Dislocation of the humerus is the result of violence directed against the arm, and not against the scapula.

Necessity for cultivating a knowledge of dislocations.

A good knowledge of the subject of dislocations should be possessed by every surgeon, for there is no accident, the ill-management of which more frequently leads to discontent and litigation than this. Although the symptoms of the majority of dislocations are palpable, and cannot be mistaken by a person of average observation, yet many are very obscure and intricate in their signs, and require long study and careful examination, before a decided opinion can be formed as to their nature. No surgeon is exempt from this responsibility, and in order to facilitate his decision, the bones of the extremities, at least, should form a part of the apparatus of his surgery; a glance at which, once or twice in the course of every year, would prove not unprofitable.

Principles of reduction.

Before proceeding to the description of dislocations in detail, I am desirous of commenting briefly on the subject of the principles which ought to guide our management, and in which I propose to combat certain opinions, and a generally adopted practice, that, in my judgment, are erroneous.

Influence of the muscles.

The affected bone is dislocated from its socket, generally, in consequence of the violence of a blow it has experienced. It remains dislocated, in consequence of the tension of the muscles inserted into it, which become the subject of a tonic contraction. This state continues, so long as the limb remains undisturbed by the efforts of the surgeon to reduce it. But no sooner is the attempt made to elongate the limb, than the same muscles, one and all, start into sudden, and violent contraction, as though for the express purpose of preventing the descent of the bone. In this unequal struggle, they contend against the yet more powerful agents of traction by pullies, yielding their ground inch by inch, till the bone is restored to its normal position, when they retire from the contest, and instantly resume their former state of repose. In the case of the dislocation of a large bone, the power exerted by the muscles, in order to retain it in its false position, is enormous, as may be readily inferred from the force employed to counteract them; and this force is also continuous throughout the whole period of the attempt at reduction; their contractile power becoming probably greater as the bone descends, and approaches the range of the ordinary contractility of its muscles.

It does not appear very reasonable to suppose that a force like that employed to reduce a bone, fixed by some of the largest muscles in the body, and often reaching that of several hundred weight, could be diverted from its straight line to any useful purpose, by the mechanical pressure of the hand, or even rotated, by the unassisted effort of one, or even of two persons. Yet surgeons often take credit to themselves for reducing the bone by such manœuvres; such as rotating the femur inwards, after extension of the limb, for the purpose of raising the head of the bone into its socket, or raising the head of the humerus in like manner, in dislocation of that bone downwards, into the axilla. An experience of thirty years of every variety of dislocation, in St. Bartholomew's Hospital and elsewhere, long since taught me the futility of such attempts, and I am strongly of opinion, that the apparent success which occasionally, *though rarely, attends them,* is due to accident alone. If the head of the femur, for example, be drawn down insufficiently, so that it rests on the outer margin of the brim of the acetabulum, it cannot be pushed over this margin into the socket by any act of manipulation, for additional extension is still required; whereas, if it has reached the requisite point, it will be instantly reduced by its own muscles.

Interference of the surgeon during reduction useless.

I have repeatedly inquired of the most experienced surgeons in the metropolis, how frequently they had witnessed the successful result of such attempts to replace the bone in its position. The answer has been invariably such as to justify me in adopting the principle I wish to urge on the attention of the reader, viz., that the immediate act of reduction is effected by the muscles, and by them alone. Remove the obstacle, bring the bone downwards, and the socket will receive it with avidity, by the agency of its own muscles, which it would appear are more powerful in a good, than in a bad cause, and which now contend more successfully against the extending force employed, even at its highest degree of traction. Such is the result of my observation. I have rarely witnessed an act of successful interference by a bystander, whereas I can bear my testimony to upwards of a hundred ingenious, though futile, attempts to enhance the value of simple extension by side-towels, lateral girds, violent twistings of the limb, even to the extent of fracture of the bone, and sudden cessation of the extending force; formerly most painful aggravations of the sufferings of the patient, and all to no purpose, because the extension is either misapplied, or is insufficient to such necessary elongation as can alone overcome the obstacle of the reduction.

Difficulty of reduction from a tendon interposed.

The occasional occurrence of difficulty from the obstruction of a muscle or tendon, which has become twisted from its position, and has prevented the return of the head of the dislocated bone into its socket, is an exception, and an infrequent one, to the above rule; and it cannot be denied, that success does not invariably attend the best-made efforts at reduction, and that the obscure and mysterious cause of this difficulty remains for ever unsolved, however perfect may be our knowledge of the anatomy of the parts involved in the dislocation.

Line of traction.

In the endeavour to reduce a dislocation, the line of traction should hold reference, less to that of the socket, or surface from which the bone has been displaced, than to the more important purpose of easing it from the surface, on which it has lodged. For example, the rim of the glenoid cavity, in dislocation of the humerus, presents an obstacle to the extension of the bone in the immediate line of that cavity; but if the bone be drawn off it, by extension made in any oblique direction, the instant this ridge is passed, the head will rush back into its natural cavity. So, also, in dislocations of the femur on the dorsum ilii, we do not attempt to draw the bone in a direct line with the acetabulum, but we carry it below, round its back and elevated margin, and no sooner does it reach the lower part of the rim, which is much less prominent than the upper and back part, than the muscles immediately restore it to its socket. The same rule holds in dislocation of the ulna and radius backwards, at the elbow-joint. I believe the exact line of extension to be much more readily determined, and in truth a less important subject of consideration, than it is generally deemed. I believe that if we bring the bone sufficiently downwards, and place it in the *neighbourhood* of the articulation, the muscles alone will replace it without difficulty.

The bone appears, as it were, sucked violently into the

Muscles the

immediate agents of reduction.

socket, even at the instant of its sustaining the greatest force of extension, because the muscles, acting with one accord, set at nought the extending power, and complete the work of reduction in defiance of all the agents employed at the moment to prevent it. The muscles are the immediate agents of reduction, and not the surgeon, whose entire duty consists in placing the bone in a position, to give them the opportunity of displaying this harmony of action, and of exercising a power, even beyond that of the mechanical agents of extension. It is this power that succeeds in forcibly drawing backwards the head of the femur into its cavity, when it has fairly reached the rim of the acetabulum, notwithstanding the force employed at that instant in extending it. In the examples of the larger dislocations, no reliance can be placed on any of the above-mentioned efforts of manipulation, but we should depend, almost entirely, on the act of simple extension, in the fullest confidence of the disposition of the joint to right itself, if the obstacles be removed. Mr. Vincent, the late senior surgeon to Bartholomew's Hospital, in his work on "Surgical Practice," takes the same view of this subject. He says, "the object to be aimed at is, to bring as perfectly as can be, the head in that situation in which the muscles can all, with one concentaneous act, draw the bone into its place in the socket."

Dislocation may be partial or complete.

A dislocation, in surgical language, may be partial or complete; that is say, that in articulations presenting an approach to a flat surface, such as the condyle of the lower jaw with its cavity, the lower end of the tibia with the astragalus, and all the arthrodial joints, such as those of the carpus and tarsus, the displacement may be more or less complete. Of this equivocal form of injury no better example need be cited than that of the ankle-joint, in which the foot may be thrown out of its relation with the tibia so slightly, that the opinion as to the actual occurrence of displacement shall obtain but a tardy affirmative of at least one-third of the authorities viewing it, notwithstanding abundant collateral evidence of severe injury. In considering this subject, we should not restrict our observation to the imperfect adaptation of the new surfaces to each other, but extend it to the muscular power which retains them in their new position. These muscles are actuated by every motive, to prevent the slightest movement of the limb. The agents of flexion and extension, being well balanced against each other, are now for the first time enlisted in the same cause, viz., that of fixing the foot, whatever its position, firmly against the tibia. The same observations will apply to the jaw, which may be dislocated on one side, and not on the other, and to other joints. It is remarkable how slight a degree of displacement of bones, having surfaces ill-adapted to each other, may be maintained by the harmonious action of the muscles inserted into or beyond them.

Early attempt at reduction desirable.

It is desirable that an attempt to reduce a dislocated bone be made as early as possible. The difficulty increases daily, by reason of the prolonged and increasing contraction of the muscles engaged, and after the expiration of many weeks, by the new fibrous adhesions, which the dislocated bone acquires. But this difficulty should not be overcharged. It does appear probable that an attempt at reduction, immediately consequent on a dislocation, takes the muscles by surprise, and the object is attained with a facility that does not reward, with equal success, the same means employed even a few hours afterwards. But supposing this rare opportunity lost, I am doubtful whether the difficulty increases in any positive degree, day by day, for some time. I do not deny that the passive contraction of the muscles demands an increasing force of extension, by the mechanical agents employed, but I consider the progress of this difficulty to be so slow, as not to present any serious obstacle to the elongation of the limb by pulleys, or by similar agents, even though many days, or even weeks, have expired since the occurrence of the accident.

Difficulty of establishing rules as to time, &c., in old dislocations.

It is impossible to lay down any positive rule, with regard to the time beyond which an effort at reduction should not be made, unless we carry the question at once into a period of a year or more; because, although our success may be improbable, the attempt is worth making, provided it be carried into effect with discretion, and it is very rarely that injury is sustained by the attempt, however powerful or long continued; indeed it is often followed by increased freedom of movement afterwards. Sir A. Cooper objects to the efforts being made to reduce dislocations of long standing, and he has endeavoured to define the period at which the attempt may be made.

He gives two months to the humerus, and three months to the femur. It would appear that the increase of difficulty in the attempt to reduce a bone dislocated three or four months, arises rather from the increase of strength and firmness of the fibrous adhesions formed around the end of the dislocated bone, than from the condition of the muscles, which have probably attained their fullest degree of contraction, and have probably become partly absorbed at the expiration of two months.

Fibrous adhesions.

Cavity filled with fibrous substance.

There is, indeed, another obstacle to which I think an unreal importance is attached, viz., that of the socket of the joint becoming filled with a new growth. Nor do I understand how any soft, fibrous substance would prevent the return of the dislocated bone. Its presence might create pain, or might increase the liability to new displacement, but nothing more ; and I hardly know how it can be employed as an argument against the attempt being made, for, if successful, why should it not be absorbed ? Thus, Dupuytren speaks of thickening of the cartilages, as preventing complete apposition of the bones, when reduced. In our endeavour to form a just estimate of the true value of the three obstacles to reduction of an old dislocation, we must recollect that they are mainly founded on evidence derived from old preparations, obtained from the dissecting-room, and taken from the bodies of persons who have sustained the accident fifteen or twenty years prior. Of these three obstacles, the second presents the greatest difficulty—that of fibrous growths connecting the bone to the structures around, but especially to the shaft of the bone, on which it rests. But new growths are far less unyielding in their structure, than are the ligaments torn asunder at the time of the original accident, and when we consider the sudden nature of the accident, and the gradual influence of the extending force employed to reduce the dislocation, we can readily conceive that the former was considerably less in degree than the power of extension usually employed in reduction. To effect the complete laceration of these adhesions, the limb should be subjected, under the influence of chloroform, to powerful extension, and should be forcibly rotated in all directions. The pulleys may be employed as if for the purpose of reduction, and with considerable force. This effort should be followed by re-

Necessity of powerful extension to break down adhesions.

newed rotation, under which the adhesions will be felt, and almost heard, to crack asunder. If the patient be exhausted, the attempt at reduction may be postponed till the following day.

Gradual extension requisite in old cases.

The second obstacle, that of the contraction of the muscles, should be met by patient persistence in extension. The extending power should be employed in the most gradual manner, occupying from half-an-hour to an hour, or longer; the length of time to be determined by the power of endurance of the patient, and to whom chloroform may be repeatedly administered during the progress of the attempt. Should the attempt fail, it may be repeated at the expiration of a week, for a second time; and supposing these two efforts to have been conducted with skill and judgment, and prove equally unsuccessful, any further experiment will probably prove futile. By such means I have succeeded in reducing a dislocation of the humerus, after three months and some days escape from the glenoid cavity.*

Attempts to reduce old cases, unattended by danger.

The immense experience of Sir Astley Cooper has failed to furnish a single case of serious injury consequent on the attempt to reduce any form of dislocation. He speaks, indeed, of contusions of the muscles, and lacerations of the skin, and insensibility of the arm; but no instance of serious injury is recorded, to awaken fear or distrust in the mind of the operator, or to create an alarm lest the effort should prove seriously detrimental to his patient.

In the operation for reducing recent dislocations of the extremities, much of the success depends on the power of endurance of the patient, and this in its degree on the skilful adaptation of the agents of extension and counter-extension. Everything, therefore, depends on the good or ill-management of the surgeon. The expression of suffering, which often determines the duration of the attempt, is more frequently directed against the application of the extending force, than against that region of the limb on which this force is intended to operate. Patients do not complain of the change in the position of the dislocated bone. Their outcries are especially referable to the opposite end of the bone, or the limb. If great care be bestowed on the application of these agents of extension, much more can be effected, and success will more generally attend the first attempt at reduction.

---

* A report of the above case is given in the "Medical Times" for June, 1848.

Good management essential to success.

In the case of large dislocations, such as the humerus, femur, and tibia, everything depends on good management. A well-planned attempt at reduction does not often fail. The anatomical knowledge of the surgeon, relative to the joint, should be perfect; the apparatus complete; the immediate agents of extension and counter-extension deliberately and well applied; the cord sufficiently strong to be beyond suspicion; the staples firm; the material for protecting the skin against injury, whether consisting of wash-leather, caoutchouc, bandage, or linen, ample in quantity.

Counter-extension.

The counter-extension should be first applied; which, whether over the chest or pelvis, should be so adjusted, as not to distort the person of the patient during the extension, or throw it into any irksome position; for it must be recollected that when extension is made, the line between the two extreme points of attachment of the cords, which is composed partly of cord, partly of pulleys, and partly of the person of the patient, will be perfectly straight. The office of the agents of counter-extension is, generally speaking, that of fixing the bone from which we intend to draw, but not invariably so.

Extension.

*The agents of extension should not be applied on the dislocated bone.* That for the humerus, should be placed around the wrist; that for the femur, around the ankle, or at the extremity of each limb. In the case of the arm, from the large size of the biceps muscle, and the uncertain resistance afforded by the elbow-joint, the leather, or whatever other material be employed, is liable to slip over the joint, and negative the whole proceeding; and binding the elbow to a right angle occasions pain, by throwing the extending force on the fore-arm. This grievous error would justly attach discredit to the operator. But there remains a yet stronger reason against the application of the extending force to the upper arm: viz., that, by so doing, we are in reality drawing the bone up by the pectoralis major and latissimus dorsi, while, through the medium of the triceps extensor muscle, we are drawing down the identical bone, from which we are making the most strenuous efforts to dislodge the head of the humerus. The same arguments as strictly apply to the other example above adverted to. If the agent of extension, in a case of dislocation of the femur, be applied above the knee, it is liable to slip over the knee-joint; and the same objection holds with regard to the muscles, for we are in this case drawing violently on the rectus muscle, which is attached to the pelvis above. In the one case we are acting on the scapula, and in the other on the pelvis, both of which bones should remain passive, as regards extension.

**Chloroform.**

The patient should be reduced to a state of unconsciousness by the administration of chloroform, which supersedes the old and happily nearly obsolete practice of large venesections, or of prostration from tartar emetic. The operation is otherwise a very painful one, and fully justifies, if any operation can, the resort to this invaluable agent, employed under these circumstances, not merely for the purpose of subduing pain, but for that even more important end, of averting the opposition of the muscles engaged, and, as it were, lulling them into a condition of temporary sleep. It is difficult to calculate what proportion of the extending force is rendered unnecessary by its aid. To the end of obtaining a force of traction which shall be superior to that of the retracting muscles, we usually, in the case of the larger dislocations, have recourse to the aid of pulleys, by which the force is multiplied in proportion to the number employed. The power exerted by the pulley is enormous,* as may be inferred from the fact that the force of extension of a limb, however muscular and resisting, is consigned to the charge of a single individual, instead of that of five or six persons, extending by means of a cord. The mechanical force of the pulleys effects another important object, when employed for this purpose. It ensures a gradual and steady extension, and is carried into effect without a moment's

**Relieves pain and relaxes the muscles.**

---

* It is well to be aware of the actual amount of force which we employ in any given case. When the same string passes round any number of pulleys, and the parts of it beween the pulleys are parallel —as in the apparatus commonly used for the reduction of dislocations— there is an equilibrium when the power is to the resistance as 1 is to the number of strings at the lower block. If, therefore, there be three pulleys at the block, as in the apparatus employed at St. Bartholomew's Hospital, the force exerted will be increased sixfold.

remission of the extending force, and by which the contracting muscles are exhausted.

The extension should be made slowly, steadily, and uninterruptedly. The necessity for increased tension should be telegraphed by a nod to the assistant in charge of the pulleys. The surgeon in chief should stand at the head of the dislocated bone, one or both hands being applied to the limb continuously, throughout the entire operation, lest the extension be continued after the bone has slipped silently into the socket. Every addition to the tension of the cords should be followed by the cessation of one or two minutes, in order to give the muscles time to relax spontaneously; during which, the surgeon will examine the limb, from time to time, in order to determine whether the bone is descending in the requisite line. Some force of pressure is required for this purpose, owing to the tension of the skin; but still it should be done without violence, or unnecessarily bruising the surface. In this manner the operation may be continued for a period of from half to three-quarters of an hour longer, to be determined either by the reduction of the bone, or by the suffering of the patient, supposing the effect of the chloroform to have ceased. The older the dislocation, the more gradual should be the effort, and the longer applied; and I have often felt inclined, in obstinate or protracted cases, to continue a tolerable degree of extension, for some hour or two, or even longer, in the hope that the muscles would yield to the unremitting and exhausting effect of continued tension upon them. I have no actual experience resulting from the application of this principle, but it appears reasonable, and may be safely adopted.

Evidence of reduction.

The return of the bone into its cavity should be carefully noted by the surgeon. It is generally, but not invariably, characterised by a slight shock given to the limb, which the patient himself is often the first person to note. It is occasionally, in the larger joints, attended by the palpable, and even the audible presence of a dull sound; but it may almost invariably be felt by any attendant whose hand shall happen at the moment to be in contact with the limb.

All the appliances should now be removed, the joint supported by bandages, and the patient placed carefully in bed, in such a position as will ensure to the affected joint the most perfect ease. The reparatory agents restore the limb to utility with wonderful celerity, when we consider the extent of the injury that occasionally appears, from the nature of the case, inevitable.

## DISLOCATION OF THE LOWER JAW.

Construction of the joint.

The articulation of the lower jaw is composed of the transversely elongated head of the bone, and the glenoid cavity of the temporal bone. Between the shallow socket of the latter and the head, is interposed an interarticular cartilage, adapted to both surfaces, and also to that of the eminentia articularis, upon which the condyle can be drawn at will out of the socket, by the external pterygoid muscle. The joint has but one, and that an external lateral ligament, although allied in structure to the principle of the ginglymoid joints, which have invariably two. The reason of this arrangement is found in the fact, that the lower jaw, though a single bone, moves on two joints, of which the external lateral ligament of one side performs the functions of an internal lateral ligament of the other, the true internal lateral ligament being absent. Both behind and on the inner side, the joint is bounded by bone, by which structure simple dislocation is rendered impossible in the inner, outer, or posterior direction. The joint is so unprotected anteriorly, when the mouth is open, by the exposure of the condyle, that the slightest force applied at the moment, will suffice to effect a displacement of the bone from the glenoid cavity, and bring it in contact with the posterior edge of the temporal muscle, against which it rests.

Causes of its dislocation.

The causes of this accident are almost invariably internal, and are rarely the consequence of external violence; although such causes are recorded as occasionally producing it, such as violent efforts at extraction of a tooth. The immediate cause of dislocation of the lower jaw, is sudden contraction, allied to spasm, of the external pterygoid muscle. When the mouth is thrown open to an unusual degree, from whatever cause, whether in yawning or laughing, or in the effort to receive into its cavity a larger object than the separation of the teeth can admit without effort, the attachments of this muscle are elongated; in other words, it is stretched, and spasm follows, by which the head of the bone, close to which it is inserted, is drawn suddenly forwards with a degree of violence that carries it beyond the eminentia articularis, and the jaw is dislocated. The displacement may occur on one, or on both sides, but generally on both. Increased liability to this accident occurs in some persons who have a preternatural laxity of the ligaments, and in whom the movements of mastication produce a continued jarring noise, as though at every action of its muscles the inter-articular cartilage was dislocated from its position. The muscles of mastication are all preternaturally elongated. The severe pain which attends dislocation of the jaw is attributable, I conceive, rather to the permanent extension exercised on the temporal, masseter, and internal pterygoid muscles, than on pressure of the nerves, as supposed by Boyer; and I am the more readily inclined to doubt this supposition, because the pain is not confined to the situation of the nerves, but extends to aching of the temples, and over the whole of the region to which the muscles are attached.

Symptoms.

The symptoms of this form of dislocation are generally, but not invariably, detected without difficulty. I have, on more than one occasion, known dislocation of the jaw to be detected only by very careful observation and inquiry.

The mouth is thrown open, or rather the lower jaw is carried downwards at the symphisis. The obliquity of its base is much greater than when the mouth is opened to its greatest limit in health. The cheeks and angles of the mouth are drawn tight. The zygomatic muscles, that expand the orifice of the mouth in the lateral direction, cease to act freely; the saliva, the secretion of which is probably increased by irritation of the parotid gland, and now no longer swallowed, flows copiously from the mouth. The masseter is tight, hard to the touch, and painful on pressure. The same remarks will apply to the internal pterygoid, felt within the mouth. A depression is felt immediately in front of the tragus of the external ear, the situation of which, before the accident, was occupied by the condyle. The articulation of words is rendered exceedingly indistinct. Add to these the important evidence, that the present condition occurred while the patient was in the perfect possession of the functions of the lower jaw, whether for speech or for mastication; that it followed suddenly an act of yawning or vociferous laughter, from which moment the jaw was fixed, and the mouth thrown open. These symptoms, usually so palpable on the occurrence of the accident, become, as Sir A. Cooper observes, less distinct in the course of a few days: and probably at the expiration of a year or two, some degree of mobility of the jaw, as well as extension of the cheeks and lips, would return.

**Principle and mode of reduction.**

The principle of reduction is very simple: the accomplishment by no means so, in the average of cases. It consists of making a lever of the dislocated bone, the force or power being applied to the symphisis at the chin; a fulcrum is formed by the application of the two thumbs, well protected, and pressed on the last molar teeth, or, if absent, on the jaw itself; the weight is placed at the extremity of the bone, and is represented by the contractile force of the muscles. This is the principle usually described; but it is greatly deviated from in the act of reduction, for the thumbs, instead of being passive fulcra, become active agents of depression of the bone. To effect this, the patient should be seated on a low stool, or, if above the average height, on the ground, and the head supported by a third person. The thumbs should be passed backwards as far as possible, in order to increase their distance from the power, and the chin grasped by the two hands. The jaw should now be forcibly depressed by the thumbs, and at the same moment, the chin raised; and the head of the bone will, by this continued effort, pass backwards into the glenoid cavity, care being taken to remove the thumbs from between the teeth on the instant of its reduction. If, instead of this usual proceeding, we employ two corks, or the handles of two table-knives, or pieces of wood, as substitutes for the thumbs, then the principle of the lever is more perfectly effected, in the forcible effort to depress the angle of the bone by raising the symphisis. The former plan is the more simple, and though generally successful, requires considerable manual power in the operator. After the reduction, a bandage should be applied, for the purpose of giving support to the jaw for a few days. (See BANDAGES.)

In the case of a single dislocation the same principle is required for the reduction.

## DISLOCATION OF THE STERNAL END OF THE CLAVICLE.

Construction of the joint.

This articulation is not unlike in construction that of the jaw. The clavicle is fixed to the sternum by an anterior, superior, and posterior ligament, and the joint has an interarticular cartilage, with two synovial membranes.

Cause of dislocation.

Dislocation is rare; not because the mechanism of the joint is strong, but because the bone itself is weak, the external force being expended on its fracture, not on its dislocation. The cause is referred to violence directed against the shoulder, generally in a fall. It occurs far more frequently *forwards* than backwards, and for this reason, that in falls forward the force is expended on the arm, which is instinctively thrown out to break the fall. A severe blow on the shoulder, when drawn backwards on the chest, lacerates the ligaments, and the head of the clavicle is thrown on the sternum.

Symptoms.

The symptoms of this injury are indicated by immobility of the shoulder and upper arm, and the great disinclination on the part of the patient to move it in any direction; by the approximation of the entire shoulder and arm to the mesial line of the body, as occurs in all injuries to the clavicle, which, as the radius of the upper extremity, affords freedom of movement to it only when entire and in health; by the presence of a considerable tumor at the upper end and side of the sternum; and by the head being drawn downwards, for the instinctive purpose of relaxing the sterno-mastoid muscle.

Dislocation backwards.

Dislocation *backwards* is a rare form of accident, of which I have seen but three examples, and all chronic. The cause is a blow on the shoulder when drawn forwards, or what is more probable, the sudden force of the sterno-mastoid muscle, while the head is temporarily fixed. Richerand mentions the case of a man who met with this accident, while leaning backwards to place a burden on a shelf behind him.

The symptoms are somewhat more difficult of diagnosis than those of the former accident. They consist in the obliquity of the line of the dislocated bone, as compared with its fellow; the indisposition to move the upper arm or shoulder; the absence of the head of the clavicle from its natural position; and the nature of the accident should also be taken into the calculation. I have never witnessed the difficulty of deglutition and respiration described by the old French surgeons as characteristic of this injury, nor can entire confidence be placed in the statements made on this subject.

Principle and mode of reduction.

The principle of reduction is that of elongation of the clavicle, and may be attempted in either of two ways; first, by extending the shoulder backwards; and, secondly, by extending it outwards. The first corresponds with the mode adopted to extend the clavicle in fracture of that bone. The patient being seated on a low stool, extension should be made by the two shoulders being drawn forcibly backwards, while the counter-extension is effected by placing the knee against the spine. This mode of extension is generally found sufficient to draw the head of the clavicle backwards into its cavity, when thrown forwards on the edge of the sternum; but a greater effort and more continuous extension is requisite for the purpose of dislodging the bone from its situation, in dislocation of the head backwards. If this mode of extension be found insufficient, the patient should be placed in the sitting posture, and the trunk fixed, by means of a broad belt of sheeting drawn round the chest, and extension from the arm should be carried out in a straight line from the body, and drawn a little backwards or forwards, as the direction of the clavicle may determine.

After treatment.

When the bone is reduced, a *large* pad of soft material, such as a pair of worsted stockings rolled up tightly, should be immediately placed in the axilla, and the arm brought to the side. By this means, permanent extension is maintained, and the escape of the bone prevented. The arm should be firmly bound to the body, the shoulder supported, and the clavicle fixed in the direction opposite to that in which it has been thrown by the accident. If dislocated forwards, a firm pad should be bound over the head of the bone.

## DISLOCATION OF THE SCAPULA FROM THE ACROMIAL END OF THE CLAVICLE.

Construction of joint.

This is an arthrodial joint, consisting of the adaptation of two plane surfaces, and fixed together by a superior and inferior ligament.

Dislocation.

The single dislocation to which it is usually subject, is caused by a blow on the shoulder, by which the acromion process is forced in, under the clavicle. The separation of the two bones is slight, owing to the tenacity of the coraco-acromion ligaments, which, being on the stretch, limit the degree of separation. The symptoms, as regard the arm, correspond with those attendant on the last form of dislocation. A small enlargement is apparent on the acromion, which should be carefully compared with the opposite side.

Principle and mode of reduction.

The principle of reduction is also identical with that of dislocation of the sternal end of the bone. The shoulders should be drawn backwards, or the arm outwards, and slight pressure be made on the dislocated bone, which will pass into its position without much effort. To retain it in contact with the articular surface of the acromion is always a difficulty. This end, however, will be attained by a firm compress on the articulation, full extension of the shoulder by means of a compress placed in the axilla, and elevation of the entire arm, which should be fixed to the side in a sling. A case is related in the sixteenth volume of the "British and Foreign Review," of dislocation of the clavicle from the scapula, produced by the kick of a horse, the acromial end being driven under the acromion. The mode of reduction in this case would be nearly the same as the above—permanent extension by a pad in the axilla, but no elevation of the arm.

## DISLOCATION OF THE HUMERUS.

The humerus is more frequently the subject of dislocation, than the sum of all the remaining bones in the body. This fact is due both to the utility, and to the great mobility of the upper extremity. In reference to the former, we must recollect that the arm is our only agent of defence; that it guards the trunk against danger with an active and vigilant observance; that it protects us against blows and falls, and violence of almost every kind, while its mobility is such as to carry it in all directions without effort, embracing in its extent of motion nearly half a sphere. Its peculiar construction, no doubt, contributes its share to the liability; for though it is classed by common consent among the enarthroses, or ball-and-socket joints, the socket is so shallow as to admit little more than a third part of the nearly spherical head at one time. It is on this shallowness of the cavity that the mobility of the limb depends, to the depth of which, indeed, a slight addition is made by the glenoid ligament, which encircles it. The articulation is surrounded by a fibrous capsule, attached above to the exterior of the neck of the bone, and connected indefinitely to the shaft, below the cartilaginous surface on the head, where it is intermixed with the tendinous insertions of the muscles, which are here lost upon the bone. These muscles are the supra spinatus and biceps above, the subscapularis on the inner side, the infra spinatus, and teres minor, on the outer side, and the triceps below. An expansion of the tendons of the supra and infra spinatus, teres minor, and subscapularis, tend materially to strengthen the fibrous capsule. The tendon of the biceps passes over the joint, entering a fissure or canal in the capsule, and in the bone below it, and the triceps behind is only in contact with the articulation when the arm is raised. A bony arch exists above the shoulder-joint, formed by the junction of the clavicle with the acromion process of the scapula. From this bony arch arises the deltoid muscle, which in its descent is thrown outward by the head of the humerus, by which it may be said to be supported; so that, in the normal condition of the joint, the deltoid projects in a rounded form, the fibres of its origin being nearly horizontal. On the inner side of the shoulder-joint, the coracoid process of the scapula may be felt between the deltoid and pectoralis major muscles, and over the joint extends the coraco-acromion ligament. The pectoralis major, arising from the clavicle, sternum, and ribs, forms the anterior margin of the axilla. The general action of this muscle is that of approximating the arm, when extended, to the side;

**Construction of joint.**

**Relation of the muscles.**

but inasmuch as a large part of the muscle is placed below the level of the joint, this portion will tend, under some circumstances, to draw the head of the bone downwards. The same remark may be made with respect to the latissimus dorsi, which, connected with the lowest region of the back, will possess a similar power.

I have given the above sketch of the general construction of the shoulder-joint, in order to recall to the reader's recollection the parts involved in the dislocation of which it is the seat; not with the idea of connecting with its structure the cause of them.

Cause of liability to dislocation.

The shoulder-joint is peculiarly liable to injury, not because the head is large and the socket shallow, or the ligaments weak, but rather because it is more exposed to injury than any other joint in the body. Its liabilities exist in a far greater degree from external, than from internal causes. There is, perhaps, scarcely a joint in the body that could withstand the violence to which the shoulder-joint is occasionally subjected. It is more correct to say, that this articulation is liable *to violence*, than that it is liable to displacement. What is the power of resistance of the human mechanism, in comparison with the mechanical force that may be brought to bear upon it? Ligaments, tendons, muscles form a very inefficient protection against external force operating upon a joint; and it does appear to me a limited view of this subject, that which deems any given part free from danger, because nature has clothed it in a stronger mantle. The size and strength of the ligaments are suited to the daily wants of each part, and to the force of its muscular contraction; and under the best circumstances, they form but a limited protection against injury from mechanical force.

Varieties of dislocation.

Sir Astley Cooper, the highest authority who has written on this subject, divides dislocations of the humerus into four; first, downwards, into the cavity of the axilla; second, inwards, on the chest, with the head of the bone lying in contact with the ribs, at the extremity, or on the inner side of the coracoid process, and resting on or under the edge of the pectoralis minor, in the subclavicular fossa; third, backwards, on the dorsum of the scapula, and, fourth, a partial dislocation, in which the head of the bone lies on the lower edge of the glenoid cavity. But this division, however correctly it expresses the situation of the head of the bone, is, for reasons to be afterwards stated, not so valuable in a practical point of view, as such a division would prove in the case of other joints; first, because it does not infer a distinct difference in the direction of the force causing the injury; and, secondly, that it does not, in any material respect, require a modification of the means resorted to, in the attempt at restoration. This will not hold in the case of the hip-joint, for example, in which the position of the head of the bone is determined by the direction of the force dislocating it, and in which the attempt at reduction, that would be applicable in one form of dislocation, would be less so in another. In all these forms of accident, the fibrous capsule is more or less lacerated, while the extent of injury sustained by the various muscles and tendons surrounding the joint, depends on the suddenness and the violence of the force that has effected it.

**Muscles lacerated or detached.**

When the head of the bone is thrown into the axilla, its most frequent form of displacement, it is probable that the tendon of the biceps escapes from the groove in the bone, by reason of the capsule which retains it being lacerated and loose, while the supra-spinatus muscle is painfully elongated. The upper fibres of the subscapularis will either be partially detached from the bone, or be similarly stretched. When the head of the humerus is thrown inwards on the chest, the same remark will apply to the infra-spinatus and teres minor; and these two muscles are especially liable to be detached from the bone, or lacerated, in the case of dislocation of the head, backwards, in which it would appear almost necessary that the subscapularis also be torn asunder; yet I do not believe that it is so. It is difficult, however, to obtain certain information on these points, from the infrequency of death consequent on recent injury; but, considering the comparative slightness of the pain, when the head of the bone is out of the socket, so long as the arm is at rest, and the rapid progress patients make towards recovery after reduction, it may be doubted, whether the injury sustained by the muscles around, is so serious as has been generally represented.

**Laceration of muscles not general.**

**Causes of dislocation.**

In considering the causes of dislocation of the humerus, we should always keep in view this remarkable feature in the construction of the shoulder-joint, that it is formed by the head of the bone revolving in a *moveable*, not a fixed, socket; and however justly chargeable the ligaments of the articulation may be with weakness, the fact alone of its great mobility affords it a degree of indirect strength, which more than compensates for their weakness; and I conceive that the knowledge of this mobility is essential both to that of the nature of the cause of dislocation and to the principles on which the reduction should be attempted.

The cause of dislocation of the humerus may be generally assigned to a fall. It is quite possible that the head may be displaced from its socket inwards, by a violent blow given to the olecranon, if the arm at the instant be thrown backwards; but this cause, for obvious reasons, must be a rare one. At the instant of falling, the arm is thrown out from the body for protection, and, should it meet in the act of falling, with any obstacle coming in contact with it, before the hand reaches the ground, or should the arm be so extended as to reach the ground at the moment at which the shaft of the bone is placed at a very obtuse angle with the socket, the bone will be forced downwards through the capsule, and become dislocated.

Concentration of force directed against the joint.

In the act of falling, the arm is mechanically thrown out, without calculating the obstacle it may first come in contact with. If a person be thrown down with violence, while standing sideways at some feet distant from the edge of a chair, and the extended arm be caught in the fall by the edge of the seat, about two-thirds of the way down the fore arm, the whole weight of the body superadded to the force of the impulse, bears upon the capsule of the shoulder-joint, and its laceration is inevitable. We have here two forces meeting in the centre by a long and powerful leverage; first, the arm, the remote end of which has a firm fulcrum on the chair; and the second, the body, the impetus of which can have no possible interruption, and the whole force is expended on the capsule of the joint, with a weight of many hundred pounds. It is not, therefore, surprising that the capsule yields to the force, and it would probably yield were it double or treble the natural thickness.

One primary dislocation only.

This is the cause of the one *primary* dislocation of the humerus, by which the head of the bone is forced from its contact with the glenoid cavity. So long as a person lies in the position in which he fell, the dislocated bone remains in its situation below its socket. The *subsequent* position of the bone, whether in the axilla, under the pectoral muscle, or on the dorsum scapulæ, depends on other circumstances, viz., its relation to the trunk, in the act of being raised; for as it is very rare that the then elevated position of the arm be retained for a moment, the arm falls, and the fall of the arm, which constitutes some considerable addition to the primary accident, and is, no doubt, often the continuance of the original violence, inasmuch as a person makes an immediate effort to rise, determines the future position of the head of the bone, and the name applied to the form of dislocation. Thus we speak of dislocation, downwards, forwards, or backwards.

Position of bone determined by direction of the arm in its fall after dislocation.

It is by this secondary force that injury is sustained by the muscles around, and as that, though considerable, is materially less than the primary force of the fall, it is not surprising that patients so quickly recover the movements of the arm. This is the only division of primary and secondary dislocation of the humerus that I am acquainted with; and I quite agree with Mr. Pott and Sir Astley Cooper in their opinion, that a new displacement, caused by a subsequent contraction of the muscles, occurring without a second accident, of which, indeed, one example is recorded, is almost impossible. It does not appear an unreasonable assertion, that there is in reality but one form of primary dislocation, viz., that in which the head of the bone is in the first instance thrown downwards. The most common position for the bone to occupy is that in the axilla, in any part of the line between which, and the extreme position inwards, the head of the bone may rest. There is no definite point at which dislocation into the axilla, as it is called, becomes dislocation inwards under the pectoral muscle. It is a matter of opinion, except when very positive, and so long as there is a variety of authority, there will be variety of opinion.

It is not, I think, difficult to explain the comparative frequency of the displacement into the axilla, and the infrequency of that on the dorsum scapulæ. The explanation is found in the natural position of the arm with regard to the chest, and the general economy of the

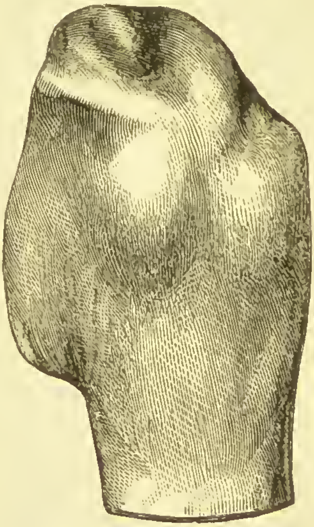
Cause of the liability to dislocation into axilla.

body. In a fall forwards, both arms are brought into requisition, and therefore the occurrence of injury is less probable; whereas, a side fall involves one arm only, the other being uselessly placed at the opposite side of the trunk. If this reasoning be correct, no fall but that in an oblique direction forwards, in which possibly the opposite extremity may be paralysed, or engaged in some very important duty, such as carrying an object of value, could become the cause of that primary form of dislocation, of which the secondary effect would be a displacement backwards on the dorsum scapulæ. A man cannot very easily sustain a dislocation of the humerus, who falls directly backwards; while a fall forwards engages the protective effort of both upper extremities, and the facility with which the force of the concussion from behind is modified by the sudden extension of the foot forwards, also contributes to render dislocation in the posterior direction very rare; but that of a fall outwards, which paralyses at the instant the services, both of the other arm and the leg of the same side, is necessarily the most frequent cause of primary dislocation, from which, according as the arm meets its resistance when drawn more or less backwards, is the head of the bone thrown into the axilla, under the pectoral muscle, or at any intermediate position between them. The above principle may prevail, although the attitude of the man's body continue vertical. My friend, Mr. Henry Landor, of Burton-on-Trent, told me of a case of dislocation of each humerus into the axilla, of a butcher in the act of raising a calf, which fell backwards over his head. He reduced both dislocations, with his heels in the axillæ. Several similar cases have been recorded in the *Lancet* and elsewhere.

Symptoms of dislocation.

The *symptoms* of a dislocated humerus, though generally palpable, are not invariably so. Many kinds of accident about the shoulder may raise a suspicion of dislocation, while genuine dislocation is rarely mistaken. Contusions of the deltoid muscle, followed by inability to raise the arm, particularly if occurring in a person of small muscular development; fractures of the head of the bone; severe blows on the acromion, also precluding the action of the deltoid or supra-spinatus; wasting of the deltoid from long disuse, or from disease of that muscle; or paralysis, from injury to the circumflex nerve, may be mistaken by an inexperienced eye for dislocation of the humerus. But a rule prevails in regard to the dislocation of this bone, similar to that which applies, indeed, to all other forms of dislocation, and to all positive disease in every part of the body; viz., that, however liable we may be to mistake the resemblances for the real affection, we rarely mistake the reality for the resemblance. Whenever, after some care being bestowed on the case, the question is raised, is this dislocation, &c., or not? in nine examples out of ten, whether the principle apply to a supposed dislocation, to hernia, or to aneurism, it may be answered in the negative. For the symptoms of most diseases are positive in their nature and unmistakeable, and, in their aggregate, are generally conclusive; whereas, in the imitations, the attention is directed to one or two symptoms only, which it has in common with the real disease, and the conclusion is hastily arrived at, that the patient has sustained the more serious form of injury.

Relative value of resemblances and realities.



Of all the characteristic symptoms of dislocation of the humerus, that of flattening of the shoulder is the most striking. The deltoid muscle having lost the support of the head of the bone, falls vertically to its insertion below. If we press the fingers upon it, although it is in a state of considerable tension, it conveys the sensation of hollowness underneath; and especially so, if the arm be extended during the pressure. Compare this form of the shoulder with the opposite, and the difference between the two is obvious. The bony origin of the muscle from the acromion is become quite distinct, in consequence of the almost right angle which it now forms with the descending muscle. The humerus, however, is not vertical, although the deltoid is; for the shaft is drawn outwards by the supra-spinatus muscle, and also by the deltoid; and the elbow, therefore, stands from three to six inches from the side, which it cannot be

Elbow raised from the side.

made to approach, without pain. The pain is referred to the region of the joint.

This symptom, however, is not an invariable one, for after some days, or a week or two, or even at the time of the accident, if the mobility of the head be considerable, the inner condyle can be brought to the side without pain or effort. Consequent on the partial extension of the arm, is a leaning position of the trunk towards the affected side, obviously for the purpose of relieving the tension on the head of the bone. If the patient's arm be extended, and the hand be passed upwards into the axilla, and the extended arm be freely rotated, the movements of the head of the bone will be clearly perceived. Compare this with the opposite side. It is difficult to feel the head through the pectoral muscle satisfactorily.

Head of the bone felt in the axilla.

Elongation of the arm.

The arm is elongated about an inch in dislocation in the axilla, but not generally in dislocation inwards; for, in this case, the head is placed on a level with the glenoid cavity. The great importance of accurate observation of this symptom is strongly insisted on by Dupuytren, and also by Mr. Vincent, who both have relied upon it confidently, in the absence of other evidence, and with great success, prosecuted the attempt at reduction.

Movements limited.

The movements of the arm are limited, and are more or less painful, although occasionally a patient will swing it backwards and forwards, when requested to do so, without complaint. He will also make an occasional attempt to raise it, but rarely or never to draw it to the side. The arm is reported to be discoloured by the pressure on the axillary vein in dislocation inwards; but neither from the displacement downwards into the axilla, nor in that backwards, either on the inferior costa, or on the dorsum scapulæ.

Discoloration in dislocation inwards.

An œdematous state of the entire limb is adverted to by Desault and Bell, as an occasional occurrence in dislocation of the humerus inwards. It is also alluded to by other authorities. My experience, however, would not justify my considering it otherwise than as a very rare symptom, although I have at the present time an example under my care. The head in this example lies very high in the axilla, the bone appears broken, and the arm much swollen and very tense from œdema: dislocation has existed for eight weeks.

The general aspect of the shoulder should be scrutinised from the front of the patient, at the distance of some six or ten feet, when the irregularity of the line of the bone will be readily detected by the eye. An experienced eye will often detect dislocation of the humerus at a glance. Grating of bone, allied to the sensation of crepitus, is an occasional occurrence. I have known it to exist in four or five cases; in the first and second of which, I felt persuaded that a fracture had taken place. It is possible that the bone may have been splintered.

The patient's evidence of recent injury.

If, to the above symptoms, we add the evidence of the patient himself—who will certify to the former condition of his health, his fall, and his present state of helplessness, —we have abundant and conclusive evidence that the head of the bone is out of the socket, and we shall find little difficulty in determining whether the head be thrown inwards, on to the chest; downwards, into the axilla; or backwards, on to the dorsum scapulæ.

Principle and mode of reduction.

The modes of reduction, practised by the modern school of surgery, are various. Those of the old surgeons, the principle of which consisted in the employment of the weight of the body, as an extending force, when the arm was drawn at length over a door, or a ladder, as also the application of the ambi, of still higher antiquity, are deservedly superseded by measures dictated by a sounder knowledge of the anatomy of the region. The principle now adopted, is that of drawing the head of the bone in the direction of the socket, obviating at the same time the action of such muscles as have the power of inclining it in any other than this one direction.

Extension at right angles.

Parallel extension.

Extension at 45°.

For example, if the arm be extended at right angles to the body, a mode adopted by some surgeons, the pectoralis major and latissimus dorsi would tend to draw the head down from the socket. If the bone be drawn straight downwards, parallel to the body, *after the scapula is fixed*, we should find ourselves contending against the action of the deltoid and supra-spinatus. With a view to meet these two difficulties, it is sometimes recommended that we make extension in a direction between the two lines, or at an angle of about 45°. When the surgeon has made a full examination of the case, and enabled himself to form a tolerably correct opinion of the force required to replace the head of the bone in its socket, he will determine how far it is necessary to resort to the use of pulleys, or whether his own personal efforts may not prove sufficient. Almost under any circumstances of disparity in size between the two parties, it is desirable in recent dislocation, to make this latter attempt by the employment of the simplest agents. The patient should be undressed, and placed on a mattress; chloroform should be administered, and the surgeon, sitting upon the bed on the dislocated side, places his heel (from which, it is hardly necessary to add, the boot should be removed,) which is nearest to the patient, as high as possible in his axilla. Taking the patient's hand on the side dislocated, within his own grasp, he leans slowly backwards, gradually making as much extension as he can. In drawing the arm downwards, his heel sinks more deeply into the cavity of the axilla; and unless under peculiar circumstances of difficulty, this method usually succeeds in the course of five minutes. In this operation the heel is supposed, but I believe erroneously, to act as a fulcrum, the pressure against which forces the head outwards, in the direction of the socket. Sir A. Cooper considers the mode above described, to be successful in its application to three-fourths of the cases. A second mode is that of having extension made outwards, by an assistant at the wrist. The hands of the surgeon grasp the arm, close to the dislocated end, and he then draws it forcibly upwards towards the glenoid cavity. With an aged or weak subject, this plan is occasionally successful; but for reasons afterwards to be mentioned, it exerts a far less influence on the position of the bone, than that of extension made with the heel in the axilla.

Chloroform.

Heel in the axilla.

Generally successful.

Extension of arm with elevation of the head of the bone.

Another plan is occasionally adopted, of placing the knee in the axilla, and employing the patient's arm as a lever, which is forcibly drawn downwards across it. This raises the head of the bone towards its socket, which it may occasionally enter; but if the attempt to reduce the bone by means of the heel in the axilla have failed, it is very improbable that either this, or the preceding method will succeed.

Knee in the axilla.

When the case is obstinate, and we are compelled to resort to the use of pulleys, it is recommended that the scapula be fixed by the mode of application of a round towel, or a strong oval ring of leather, either, to be firmly secured into the wall. The extending agent is then to

Fixing the scapula and employment of pulleys.

be fixed on the wrist, and not above the elbow, for reasons given in the introductory chapter. The patient may be placed either in the sitting, or the lying posture, but the latter is preferable. Chloroform being administered, the extension should be made nearly downwards, or certainly not higher than an angle of 35°, with a view to obviate the actions of the pectoralis major and latissimus dorsi. Those who recommend this plan would generally adopt lateral extension of the humerus outwards from the trunk near the axilla, by means of a second towel; but I cannot say that I have seen benefit from its employment. The extending force may be continued for thirty or forty minutes uninterruptedly. Some authors recommend the arm to be thrown across the chest, thus making a lever of the dislocated bone. Dupuytren, a man of great experience, revived a plan invented by Mr. White of Manchester, which he erroneously ascribes to the invention of a Frenchman, and which the former thus describes: "One assistant grasped the wrist of the affected arm, and raised it to a line parallel with the trunk, making extension directly upwards, whilst another assistant pressed upon the scapula, for the purpose of making counter extension. I was thus left at liberty to direct the head of the bone with my two thumbs, which I did in a sitting posture."*

**Lateral extension superadded.**

**Arm thrown across the chest.**

Of these numerous modes of reduction, there are but two which I can strongly recommend; viz., the first, with the heel in the axilla, the principle of which is, I conceive, however, greatly misunderstood, as also the source of the success that so frequently attends its employment; and, secondly, that of Mr. White, adopted by Dupuytren. A few days since, M. de Meric, at the Royal Free Hospital, reduced a very recent dislocation by simply raising the arm. With respect to the plan of placing the heel in the axilla, it should be constantly kept in mind, that the shoulder-joint has this peculiarity in its construction, viz., that it is composed of two bones, each of which is moveable on the trunk, and that, in the act of extension, we not only affect the position of the bone we are extending, but, through the agency of the muscles connecting them, we also affect the relations of the bone we are extending

---

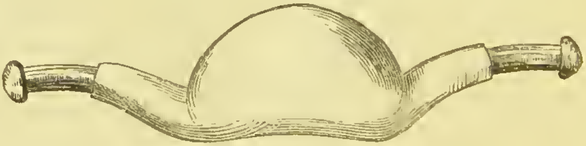
* Dupuytren on Injuries and Diseases of Bones. By Le Gros Clerk.

*from;* and in the case of the humerus and scapula, that the agents of extension do affect both bones, cannot be doubted. By fixing the scapula, we retain the glenoid cavity in a direction looking straight *outwards* from the trunk; but if we leave the scapula untouched, then, by the act of drawing down the humerus, we depress at the same time the acromion, by means of the deltoid which is attached to both. The consequence is, that in depressing the acromion we *direct the socket of the bone towards the dislocated head*, and readily get rid of the obstacle, which is often immediately caused by the rim of the glenoid cavity alone, and we bring the two surfaces of bone within the range of what I may term their natural affinity, and by the agency of which they immediately coalesce. With the heel in the axilla, we make a simple extension of the arm from the wrist; we leave the scapula unfettered, to assume its own direction; and by the extending force, slightly as it is applied by one person only, *the scapula is made to revolve on its centre, through the leverage exercised on the acromion by the deltoid;* and the pectoralis major and latissimus dorsi, being thus relaxed, exercise no prejudicial influence on the movements of the humerus. I have seen the protracted efforts of pullies, drawing outwards, fail again and again, with the utmost effort, when the head of the bone has been restored to the glenoid cavity, by the single agency of one person subsequently placing his heel in the axilla.

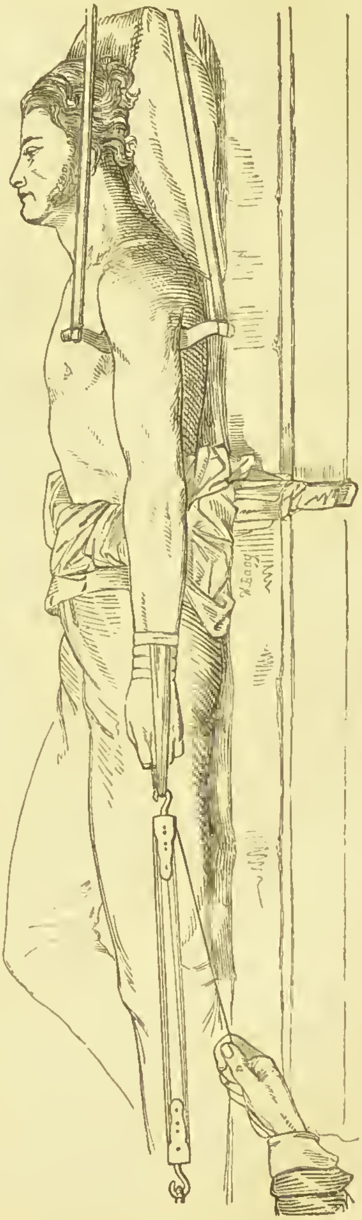
Fixing the scapula, useless and objectionable.

There is no reason why, in very muscular subjects, or in old dislocations, the same principle may not be applied conjointly with the use of pulleys. For the purpose of retaining this admirable, because most efficient, principle, I employ a well-padded iron knob, which may represent the heel, from which there extend laterally two strong branches of the same metal, each ending in a bulb or ring of about four inches in length, the office of which is

Pulleys applied on the principle of the heel in the axilla.



designed to keep the margins of the axilla as free from pressure as possible; for what operation can be more absurd than the endeavour to fix the scapula by means of girds carried round the shoulder, in which we include the margins of this cavity, viz., the pectoralis major and latissimus dorsi, as in a vice, and by which we endeavour to drag up the arm, *at the same instant that we make the most strenuous efforts to drag it down by a yet superior force?*



It is of the utmost importance, if we wish for success, that we have the margins of the axilla untrammelled, in order that the bone be allowed to descend, unchecked at least by our own agency. The iron knob should be passed high up into the axilla, and attached to cords fastened into a staple.

The person of the patient should be placed on the back, or inclined over on to the opposite side, and the cords passed up on each side of the shoulder, one in front and the other behind the joint; the arm should be drawn downwards, as nearly as possible parallel to and in contact with the body. Extension should be made from the wrist, and, especially in old cases, continued gradually. As the humerus descends, the scapula will roll forwards, and the glenoid cavity, instead of staring away from the head of the humerus, will be directed downwards towards it, in the axillary cavity, or equally so when under the pectoral muscle; and although I have never employed the same means in reducing dislocation on to the dorsum scapulæ, I have no doubt of its power to accomplish it.

On the above plan I have succeeded in reducing a great many dislocations, whether occurring in very muscular men, or after some days, or weeks, or even months duration; and it is, I conceive, especially applicable to such cases of long standing as require long and persistent extension.

Extension upwards.

The plan of Mr. White of Manchester, by which the arm is drawn upwards towards the head, has this objection, viz., that it applies considerable force in a very distorted line, and one would imagine that it could not be effected without injury sustained by the subscapularis muscle; yet Dupuytren speaks of a dislocation reduced in this manner, in which the patient had recovered the free use of the arm *in twelve days.*

Of the numerous methods above alluded to for reducing the dislocated humerus, it is not intended that all, or even many, should be adopted in any one case. The first, and most efficient, should perhaps be first selected, viz., the heel in the axilla. Should this measure fail, it is better to resort to the pulleys at once, as the most certain method of effecting the reduction. I have recently seen a case of dislocation of the humerus, in a powerful man, reduced within two minutes by being raised over the knee of a house surgeon of not more than ten stone weight. The patient was placed under the influence of chloroform, to the operation of which this remarkable result was attributable.

Chloroform.

## DISLOCATIONS AT THE ELBOW-JOINT.

Dislocations at the elbow-joint exhibit the greatest variety, and also the greatest complication of any joint in the body, in which condition they present difficulties of the most formidable kind to the surgeon, and occasionally, nay often, defy the diagnosis of the most experienced members of our profession. This difficulty is founded on the compound nature of the joint, the existence, and the variety of so large a number of projecting processes, each of which is liable to injury, and to the thick investment

Cause of difficult diagnosis of elbow-joint.

of muscle, with which nature has covered the front of the articulation.

Structure of elbow-joint.

The humerus terminates below in its two condyles, of which the internal one projects considerably. The ulna embraces its articular surface, by means of a considerable concavity, terminating in front of the coronoid process, which, in extreme flexion of the arm, is received into the anterior depression of the humerus, and behind in the olecranon, which, in extension, falls into the posterior and larger depression of that bone. The head of the radius revolves on the articular surface of the outer condyle, and also in the lesser sigmoid cavity of the ulna. It is distinctly felt in rotation on pressure of the finger, applied a good way back, immediately below the outer condyle. Of these processes, the coronoid, the outer condyle, and the head of the radius are closely invested with muscles, the internal condyle and olecranon are prominent.

The front of the joint is covered by the brachialis anticus, by the tendon of the biceps, and its aponeurotic expansion, lost below in the fascia of the fore-arm, by the brachial artery and median nerve. The large mass of muscles on the outer side, covering the condyle and the head of the radius, consists of the supinators and extensors, which, for the most part, arise above, from the humerus. That of the flexors takes its origin from the internal condyle only.

Causes of dislocation.

As to the causes of dislocation in this region, it would be difficult to follow them in all their variety; no doubt they are generally the result of falls on the fore-arm or hand; but the fall and its consequent dislocation are so instantaneous, that a patient is rarely competent to give any satisfactory and precise report of its nature, and we can only infer its direction from the form of derangement the structure has sustained. Its frequent complication with fractures of one or more bones, greatly increases the difficulty; and this is yet further aggravated by the frequent occurrence of large ecchymoses and other forms of swelling which may entirely conceal the outline of three-fourths of the articulation. Under almost all circumstances, however, two points are visible, viz., the internal condyle and the olecranon. In almost every variety of injury of the joint these two processes are felt without difficulty, and for this reason, that their relation to the integuments in health is so close, that it is very rarely that the cellular connection between them is infiltrated with blood. The relation between these two important landmarks should be distinctly understood, and fixed in the memory of the surgeon, as the knowledge will be found, in cases of complicated injury, always valuable. In the extended position of the arm, the centre of the olecranon is about an inch underneath the condyle, in the vertical direction; and when the arm is bent at a right angle, the olecranon is in a right line with the condyle, and about an inch and a half below it.

Diagnosis difficult when the arm is swollen.

Severe injuries of the elbow-joint, whether in the form of fracture, dislocation, or a compound of the two, are frequently followed, at a short interval, by swelling of a formidable kind, in which it is impossible, but by the aid of a perfect intimacy with the anatomical structure of the joint, to detect the relations of one part with another; but even under this difficulty, the two points in question are readily distinguishable. In such forms of swelling, the arm, including the length of six inches both above and below the joint, may be involved in the extravasation, and this swelling may distend the arm to a circumference of one-third beyond its natural size. In such circumstances, in which it is impossible to determine with any certainty whether any, or what bones are broken, or whether or not dislocated, the difficulty of the case should at once be stated to the friends of the patient.

Responsibility of surgeons in cases of severe accident.

A surgeon is justly responsible to society for the entire restoration of many forms of injury to a condition of health of the affected part, provided no extreme or unusual difficulty exist in the nature of the accident, or arise in the course of treatment; and the records of law unhappily teem with examples of a compulsory retribution, the result of ignorance or neglect. But in the case now imagined, which sets at nought the knowledge and the foresight of the most experienced, a surgeon can only render himself responsible for the issue, by the assumption of power which he does not possess, or by volunteering an unguarded pledge of his ability to restore the joint to its former condition of health. This is obviated by a candid avowal of the difficulties of the case, and by his willingness to avail himself of the co-operation of others, who can, at least, lighten his burthen by sharing his responsibility.

The penalties of law are justly enforced on those who play a single-handed game, by which they deprive their patient of the advantages to be derived from the experience of others; whereas, they should rely on the well-known adage, which under no circumstances is more pertinent than when applied to a medical man placed in this critical position, that, "union is strength."

Cases demanding consultation.

Authors do not agree in the natural division of dislocations at the elbow-joint: first, because the compound nature of the joint admits so large a variety of injury; and, secondly, because as the degree and direction of the displacement of a bone depends on the extent and direction of the force causing it; it is probable that no two dislocations of the elbow exactly correspond; and moreover, we may readily believe, that we have yet to learn all the varieties of injury, to which it is liable under the influence of eccentric forces bearing upon it.

Cause of the variety of dislocations at the elbow.

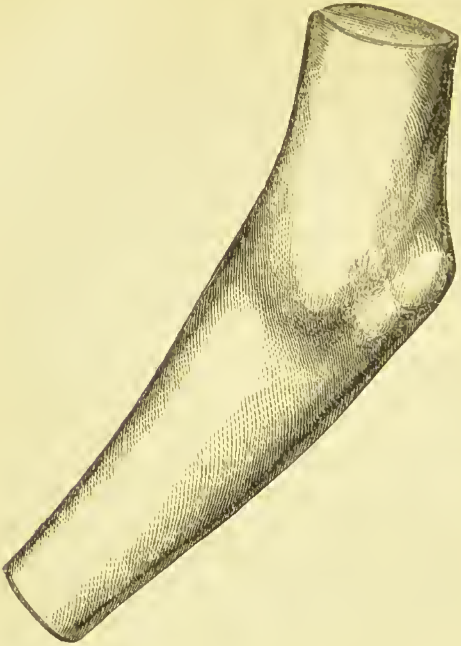
Thus, each author, taking his own experience for his guide, describes those injuries which he has seen, while it may be not unreasonably supposed, that many varieties, or at least many degrees of displacement, have escaped the observation of men of the largest experience. That of Sir Astley Cooper produces a variety of five different dislocations of the fore-arm. First, the two bones backwards. Second, the two bones thrown laterally, the radius occupying the articular surface of the ulna, and the latter bone forced off the humerus. Third, the ulna alone thrown backwards. Fourth, the radius forwards; and Fifth, the radius backwards.

Of these forms of dislocation, that of *both bones backwards* is, perhaps, of more frequent occurrence than that of all the other varieties taken together. I have observed it to have occurred most commonly in the persons of children, and almost invariably in consequence of a fall. It may be readily detected by the unnatural position of the olecranon, which projects an inch or more higher than when occupying its natural position in the posterior fossa, which is now occupied by the coronoid process. The triceps muscle is forced backwards, resembling, in its appearance, the connection of the tendo Achillis to the os calcis. The arm is slightly flexed and supinated by the compound action of the biceps, which draws the tubercle of the radius forwards; the skin in front of the

Dislocation of radius and ulna backwards.

Symptoms.

joint is in a state of tension; the projection of the humerus is apparent in front—the joint is nearly fixed, and capable only of the slightest motion in either flexion or extension. If the condyles are firmly held by one hand, the dislocated extremities of the radius and ulna can be moved in the lateral direction.



The arm should be carefully compared with that of the opposite side, and under all circumstances, inquiry should be made as to its condition before the accident. I remember a boy submitting to a painful and protracted attempt to reduce a dislocation of his fore-arm, on the failure of which, he got up with a laugh, and said, "I knew you couldn't do it; it's been out these ten years."

Principle and mode of reduction.

The attempt at reduction is recommended to be made by placing the knee in front of the elbow-joint, grasping the wrist with the hand, and drawing it forwards, at the same moment that the fore-arm is forcibly bent round the knee, employed as a fulcrum. By these means the coronoid process is detached from its position in the posterior fossa, and is drawn round to the front of the articular surface of the humerus. It is very probable that the annular ligament, connecting the radius to the lesser sigmoid cavity in the ulna, is unbroken, and the two bones will return together. Although this mode of reduction has the high sanction and the recommendation of Sir Astley Cooper, I confess I entertain the strongest objection to it; not only because I have rarely known it to succeed, except by a long-continued effort of flexion, to which additional extending power was resorted to, but because it appears to me opposed to the first principles which ought to direct our conduct in the attempt to restore a bone into its cavity.

Objections to the mode recommended by Sir A. Cooper.

My objections are founded on the following grounds: that children are more frequently the subjects of this dislocation than adults; and that in children the coronoid process is not firmly attached to the shaft of the ulna, but is yet an epiphysis, and continues such, till fourteen or fifteen years of age; that in the attempt to bend the arm, the ulna is employed as a lever of the first kind, of which the posterior part of the articular surface of the humerus is the fulcrum, the weight being represented by the triceps, attached to the olecranon; that the force employed, which with such leverage is very great, may seriously damage the coronoid process, if not fracture it; and I am satisfied that I have seen this done; that the immediate obstacle to the return of the bones is seated in the coronoid process, which causes the projection of the ulna backwards; and that by bending the arm, before full extension is made, we force this process against the bone, instead of endeavouring to detach it from the surface that appears to hold it.

Extension in the straight direction.

I have endeavoured in the introductory part of the chapter, to enforce the importance of the principle, that the general extension of the muscles in the axis of the affected bone ought to be adopted, for the purpose of bringing a bone downwards, within the range of their general, and not their individual action; and that we gain nothing by the resort to any direct line of traction, by which we give relief to one or more muscles at the expense of others; and I conceive that this form of dislocation affords abundant evidence in support of this principle, both in theory and in practice. If we examine the construction of the joint on the skeleton, it appears obvious that simple extension will accomplish everything; that it presents the readiest mode of detaching the coronoid process from the posterior fossa, or from the posterior surface of the humerus, supposing it to be forced beyond the fossa into extreme retraction; that it employs equal and fair tension both on the biceps and brachialis anticus in front, and on the triceps behind; that all that is required for success, is to bring the coronoid process below the trochlea or pulley of the humerus,—for the radius presents little or no obstacle,—

when it will rush forward to its natural surface, and the dislocation will be reduced.

Unless the patient be a very powerful man, the reduction of the fore-arm on this principle may be effected by two or three persons, one of whom would fix the upper arm, or simply retain the person of the patient in position. Extension of the fore-arm should be made from the hand or wrist, *in a straight direction* downwards, as if for the purpose of simply elongating the arm. This extension should be continued with moderate force for some three or four minutes, when the bones will slip forwards, without great effort or difficulty. A strong boy, of about sixteen, was brought into St. Bartholomew's Hospital with this form of dislocation, during the visit of the surgeon. The case was given into the charge of the house-surgeon, who was requested to reduce the dislocation, which he attempted for ten minutes without success. The surgeon himself made a similar effort, by endeavouring to draw the bones of the fore-arm round his knee, placed over the front of the elbow-joint; but he was equally unsuccessful. Simple extension was then adopted, and the bones returned to their position, comparatively with the greatest ease. This case is a type of many others.

Example.

The observation of the abnormal position of the bones, and that of the compound action of the muscles about the joint, while they would appear to point to the application of the simple principle of extension, as the best and most innocuous means of replacing the dislocated bones, receive additional confirmation from its practical application. It is very rarely that any difficulty attends this mode of reduction, which I have both taught and adopted, for many years. Dupuytren reduced in this manner a dislocation of the bones of the fore-arm backwards of eighteen days' existence, without difficulty, and Sir A. Cooper acknowledges that in one case he resorted to it with success, when the other plan had failed.

Fracture of the coronoid process.

Should the ulna return to its false position shortly after the reduction, and without the occurrence of fresh violence, it is probable that the coronoid process is broken off, and the case then becomes one of some difficulty. The simple fact of the renewed displacement of the bone without violence, goes far to prove the separation of this process. But crepitus may be occasionally felt in the extreme flexion of the arm, and if we add to these symptoms that of peculiar facility of reduction, we shall hardly be mistaken.

Lateral dislocation outwards.

The next most frequent dislocation at the elbow-joint, consists in the displacement of *both bones in the lateral direction.* They may be thrown outwards or inwards. They are, perhaps, more frequently thrown outwards, the olecranon resting on the back of the outer condyle, the radius off, or nearly off, the bone. The internal condyle projects greatly under the skin, and the olecranon is nearly two inches distant from it. The triceps muscle, retaining its connection with the humerus, passes somewhat suddenly across the olecranon. The arm is nearly straight, but is fixed as regards the power of flexion, and pronation is effected with pain. All these symptoms may be marked by swelling, following the accident within an hour.

Lateral dislocation inwards.

In dislocation of both bones inwards, the olecranon is brought directly behind the inner condyle, and projects backwards, in consequence of being deprived of its fossa. Some of the fibres of the anconeus must be torn asunder. The head of the radius may be felt, in rotating the fore-arm. The arm is fixed nearly in a straight position. By comparing the two extremities, the abnormal position of the bones will be rendered obvious.

Dislocation of radius forwards.

Dislocation of the *radius forwards,* in my observation, comes next in frequency, although I dare say, with much reason deemed a rare form of injury by some authors. It is marked by slight flexion of the fore-arm, and by the presence of an osseous swelling in front of the external condyle, due to the head of the radius, which has broken through the restraint of the annular ligament, and escaped from its contiguity with the ulna. Rotation of the fore-arm may be performed without much pain, but neither flexion nor extension, beyond the point at which the arm is fixed.

Dislocation of radius backwards.

Dislocation of the *radius backwards* is a far less frequent accident than the former. It may be detected by the unnatural contour of the joint on its outer side, and by the head of the bone being felt in rotation under the surface *posterior* to the external condyle, instead of in a direct line below it.

Other varieties.

Other varieties are spoken of; and any variety or form may occur, of dislocation of these two bones. The radius is occasionally, but rarely, thrown forwards in combination with displacement of the ulna backwards; and that form of dislocation in which both bones are forced forwards, is a recognised, though a very rare accident, which has escaped the observation of many experienced men. It is accompanied with fracture of the olecranon. In truth, if we test the liabilities of the elbow-joint to injury, by the records of surgery, they are numerous indeed; for, as I have above observed, no two authors agree in the number or order of liability, though all acknowledge the great frequency of the dislocation of both bones backward. The difficulty of making any complete classification of these injuries, after having pointed out three or four of the more prominent of them, is not important, if we resort to a general principle of reduction as applicable to all, or nearly all, and that is the principle previously enforced, of extension. Manipulation can accomplish little, while extension well applied, with such modifications as particular dislocations demand, will be found a successful means of effecting the reduction of them all. For example, in lateral displacement of both bones, the extending force employed should be moderate, and some lateral pressure by the hand on the dislocated bones, will facilitate the reduction. In dislocation of the radius forwards, pressure of the thumbs on the head of the bone, may be superadded to extension of the hand. It is unnecessary to say that the extending agent should here, for obvious reasons, be applied not to the fore-arm, but to the hand. With these and similar modifications, I believe simple extension will prove by far the most efficient agent, in the reduction of all dislocations at the elbow-joint.

Extension, the general mode of reduction.

It may be laid down as a general rule that the position that is most comfortable, is the best; but regard should be paid to the liability to a repetition of the injury by the action of the muscles. If the coronoid process be entire when replaced, there is no probability that it will, without renewed violence, escape from its articular aptation with the humerus. The muscles themselves cannot effect this new displacement, for they antagonise each other's action. But if the coronoid process be broken off, then its separation is not only possible, but highly

Treatment of fracture of the coronoid process.

probable, and great care is required, in the endeavour to prevent it. Instead of consulting the comfort of the patient, by placing the arm in a slightly bent position, the arm should be maintained in the position at which the elbow-joint is bent, at something less than a right angle. In this position it should remain till some attempt at union of the coronoid process be made, when slight extension may be commenced; not that I participate in the fears entertained by many, that anchylosis of the joint is a very probable occurrence, either in this case or in any other similar example of simple fracture extending into a joint. The arm should be bent so far, as to ensure the two surfaces of the bone being fairly brought into contact. Permanent pressure should be made on the olecranon, with a view to meet the tendency of the ulna to fall back on to the posterior surface of the humerus. This is best effected by a splint fixed along the back of the upper arm, and attached to a gutta percha sling, placed at right angles to it, or by means of two splints connected behind the elbow, by a graduated hinge. As a precautionary measure, it is better to apply in all cases a thin pasteboard splint, and to roll the arm lightly, unless where much swelling has followed the accident.

In fracture of the olecranon, attendant on the rare dislocation of the ulna forwards, the arm should be placed straight, as the only position that will ensure complete apposition of the broken bone. There need be little fear of anchylosis. With regard to the period at which motion may be allowed, it should depend rather on the sensations of the patient, than be the subject of any fixed rule. In ten days or more, a slight movement may be attempted, and if unattended with pain, it may be increased daily.

Fractures of the inner condyle, whether wholly or in part, or fracture extending obliquely through the shaft above the inner condyle, are very frequent complications of serious injuries occurring to the elbow-joint. It is a very common occurrence after the reduction of a dislocation, accompanied with considerable swelling, to find, at the expiration of two or three months, a considerable prominence of the lower end of the humerus on the inner side of the bone, and by the presence of which, the movements of the joint are greatly limited.

Necessity of moulding the joint in large complications of injury.

In those formidable cases of injury to the elbow-joint, attended by extensive swelling, crepitus from fracture of one or more bones, combined with probable dislocation, and in which, by reason of the swelling, it is impossible to determine the nature or extent of the injury, it is still very desirable to make an attempt at restoration of the bones to their natural position. For this purpose slow extension should be made as before, in the axis of the limb, and the surgeon should place his hands around the joint, and carefully employ pressure in various directions, moulding it as nearly as can be done to its natural form. The joint should be slightly twisted, and drawn laterally in various directions, till we receive the impression that we are reducing the joint into something like its natural form.

Great relief will be given to the patient by this process. Indeed, the greater the extent of injury, the greater benefit will be obtained; for although anchylosis will be the probable issue of the case, there is yet no sufficient ground on which to raise the question of amputation, even though a portion of the joint be exposed by the compound nature of the dislocation. I allude to those occasional examples of injury, which consist of a general crush of the joint, the result of a fall from a scaffold, or of any great weight falling upon it.

Case of complicated injury.

A stout gentleman, fifty years of age, was violently thrown out of his gig, and the weight of his entire body fell on his right elbow, over which he rolled heavily. I saw him within half an hour; the arm was enormously swollen from extravasation. The joint appeared crushed, and broken in all directions. He was suffering intense pain. The limb was extended steadily but gently for ten minutes, during which I endeavoured to remould the joint by manipulation, pressing forwards, backwards, and transversely, drawing the joint slightly in this direction, then in the opposite. By this continued operation I succeeded in replacing various portions of displaced bone, and of removing a great deal of his suffering. The arm was placed on a pillow a little bent, and he recovered, with slight motion of the joint. In this case I believe the head of the radius, the external condyle, and the olecranon were all broken.

Case of

A man was brought into St. Bartholomew's Hospital in the summer of the year 1835, while I was on duty for Mr. Earle, with a compound dislocation of both radius and ulna, at the elbow-joint. The arm had been almost doubled outwards, so as to expose nearly the whole of the articular cavity of the joint, and the soft parts were also a good deal damaged. The injury appeared so formidable, that I advised the immediate removal of the limb. The man strenuously refused his consent, and I had no alternative but to replace the arm and bind it up. In six weeks he recovered, and the movements of his arm, at the expiration of six months, were comparatively little impaired. Compound dislocation.

I may allude in this place to a similar case of recovery from injury to the knee-joint. A man was brought into the hospital with compound fracture of the internal condyle, and compound dislocation of the patella, by which the articular cavity of the knee-joint was greatly exposed. The parts were replaced, and the limb rolled. The man was in the hospital for many months, and eventually recovered a considerable extent of motion of the knee-joint.

## DISLOCATIONS OF THE RADIUS AND HAND FROM THE ULNA.

Cause. Violence applied on the hand may separate the lower end of the ulna from the fossa in the radius, and from its connection with the cuneiform bone, by rupture of the lateral ligament that binds it. A portion of the interosseous ligament will also probably be torn asunder. It is difficult to imagine how this accident could occur from violence applied on the ulna itself, yet it is not impossible. The relation of the dislocated radius and hand to the extremity of the ulna, depends on the nature and the direction of the force causing the injury; Symptoms. but the ulna more frequently projects backwards than forwards, presenting a considerable swelling in this direction; the fore-arm is prone, and the attempt to supinate, difficult to the surgeon, and painful to the patient. Reduction is effected by extension of the hand, combined with Mode of reduction. supination. At the same time, the extremity of the ulna should be pressed forwards into the fossa of the radius. Care should be taken, by the early application of a splint, to prevent the recurrence of the accident.

The radius and hand may be thrown backwards; while the line of the ulna is felt descending obliquely downwards, in front of the radius, on the end of which it rests, forming a projection in front. To effect its reduction, the fore-arm should be fixed, a bandage applied around the wrist, and the hand drawn outwards. At the same time, the end of the ulna should be pushed backwards with some force, when extension is fully made, but not before.

## DISLOCATION OF THE CARPUS AND HAND FROM THE RADIUS AND ULNA.

Cause.

This is commonly denominated dislocation of the wrist, and results, like the former injury, from violent force applied on the hand. The most frequent dislocation is that in which the carpus is thrown backwards. The force is generally applied to the extended palm. This, at least, is the cause to which it is commonly assigned; but I am not by any means clear that a fall on the back of the hand, when forced into extreme flexion, may not equally effect it. One reason points, however, to it as the more general effect of a fall on the palmar surface of the hand; viz., that the usual dislocation at the wrist is that in which the first row of carpal bones is thrown backwards on the radius and ulna; and generally, also, the hand would be instinctively thrown open to receive the force of the fall; therefore, we may reasonably attribute the more frequent effect, to the more ordinary cause. The carpus may be dislocated forwards on the palmar surface of the bones of the fore-arm; but this and other possible forms are exceedingly rare.

Dislocation of the carpus backwards.

That the dislocation backwards is an occasional occurrence, I am quite satisfied, having witnessed several examples of this injury, of the most unequivocal kind, which could not be mistaken for fracture of any bone; and yet this form of accident is denied by the great authority of Dupuytren, who asserts that fracture of the lower end of the radius is mistaken for dislocation. He says, and I quote his exact words:—"*In spite of all that has been said on this subject, I have never met with, nor heard of, one single well authenticated case of the dislocation in question.*"* He proceeds in a strain of very question-

Denied by Dupuytren.

His explanation.

---

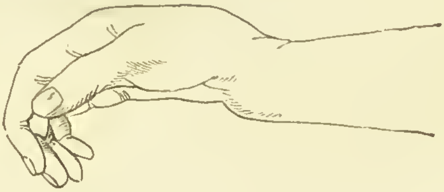
* Dupuytren on Diseases and Injuries of Bones. By Le Gros Clerk.

able reasoning to argue the impossibility of dislocation, either forwards or backwards, by virtue of the close proximity of the flexor tendons in front,—assigning to the extensor tendons the like power of prevention, behind! That fracture of the lower end of the radius may have been frequently mistaken for dislocation, is not unlikely; but the supposition, that the error is an invariable one, equals in value that which attributes the supposed variety of dislocation of the carpus to the tendons, and not to the ligaments.

The first objection to be made to this argument is, that it infers the invariable condition of contraction of the muscles engaged; the second is, that, however tense the muscles in action, lateral pressure of the bones, having already ruptured their ligaments, would suffice to force the tendons out of their straight line, consequent on the enormous double leverage it would act with, by extending from the point under pressure, along the whole line of the muscles and their tendons, up to their attachments.

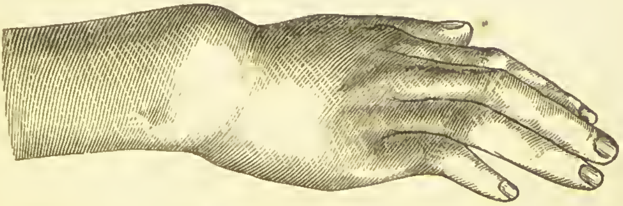
Symptoms.

The symptoms of dislocation of the carpus backwards consist in a swelling in front, caused by the bones of the fore-arm, and a line of prominence behind, from the presence of the scaphoid, lunar, and cuneiform bones. The arm is shortened, thrown into a state of supination, and is immoveable as regards flexion and rotation.



Mode of reduction.

The mode of reduction consists in simple extension of the hand, accompanied by a slight lateral movement, if required by the failure of the extending force.



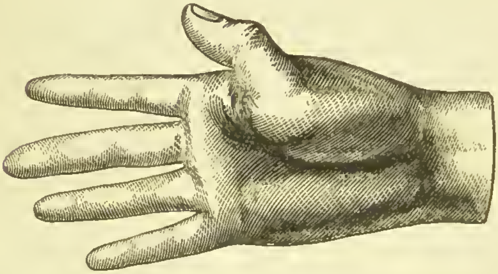
From a cast in the Museum of the Royal College of Surgeons.

Dislocation of the carpus forwards is a still more rare accident; the symptoms are sufficiently obvious, and the principle of reduction the same, as in the last form of injury. Double pasteboard splints; in fact, the treatment of fractured fore-arm is required for future recovery.

## DISLOCATION OF THE THUMB.

Cause.

The thumb is occasionally dislocated at the articulation of the metacarpal bone with the trapezium. Though generally the subject of dislocation backwards, examples of displacement forwards occur. The reason why this dislocation so generally occurs in the posterior direction is, because force is so almost invariably applied in front, whether in a fall or in the attempt to catch a heavy body, meeting in its descent with unequal force, one or other finger; for the same remark will apply to dislocation of the phalanges, which are most generally forced backwards out of their position. In this situation they are firmly fixed, partly by the tendons, and partly by the lateral ligaments which are unbroken, and partly, possibly, by the integuments.



From a cast in the Museum of Guy's Hospital.

Mode of reduction.

If the dislocation occur at the articulation of the first phalanx with its metacarpal bone, we can apply an extending force to the finger without difficulty, either by the hand, in grasping the finger and drawing in the axis of the limb; by bending the finger in flexion and pressing the bone forwards at the same time; or by forcing it backwards when extended, bringing the two articular surfaces as much as possible in contact, and then making a lever of the first phalanx, in order to force it forwards.

Application of plaster.

A good method of adopting an extending force to the finger is by means of recently made adhesive plaster, well and thickly applied to the entire finger, in many layers, including between the folds several longitudinal pieces of half an inch in breadth, till sufficient substance is obtained to ensure strength.

The difficulty of applying the extending power increases in each phalanx as we approach the last. Of the last phalanges, that of the thumb is most frequently dislocated; and for reasons before given, it is more generally thrown backwards than forwards; where it lies in a state of semiflexion, held firmly by its lateral ligaments. A circle of good plaster, of several layers, should be applied on the last half of the phalanx, and a clove hitch knot of *thick* twine placed below it, and the joint protected by lint. The office of the plaster is merely that of preventing the escape of the cord. Extension may first be made in the longitudinal direction, playing the bone backwards and forwards at the same time. Should this method fail, the phalanx should be bent forwards on the distal extremity of the second phalanx, at a right angle; then drawn forwards, till the articular surfaces are in contact. The bone should then be raised upright on to the second phalanx, with some force. Mr. Savory tells me that he has reduced two dislocations of this phalanx by pressure on the articular surface of the displaced bone, by the thumb from behind, with little difficulty. Mr. Wormald draws the hand over the patient's shoulder, by which means he considers that he obtains a more complete relaxation of the muscles of the dislocated phalanx.

Pressure on the phalanx from behind.

If these measures fail, whether in the dislocation of the last or the second joint, the lateral ligament should be divided by a fine-pointed knife, introduced for that purpose under the skin, which will at once remove the difficulty. The serious consequences that attend on wounds of the larger joints, do not apply to those of the lesser articulations, such as are now alluded to; and the probability is, that no evil would result from this division; but should inflammation follow, and even extend to the absorption of the articular cartilage, and consequent destruction of the joint, the evil would be less to its possessor, than that of leaving the phalanx unreduced for life. Time is a great object in these small dislocations. If taken shortly after the accident, they are reduced with comparative facility; but the difficulty, with every day and almost with every hour, increases considerably, and after the expiration of one or more weeks, it is often impossible to effect the restoration of the displaced bone, without division of one of the lateral ligaments. Severe inflammation not infrequently follows the reduction, where much violence has been used.

## DISLOCATION OF THE FEMUR.

Structure of joint.

The hip-joint is the most perfect example of a ball and socket, in the human body. The spherical head of the femur is received almost entirely within the acetabulum, from which the neck of the femur, in length about one inch and a quarter in front in the adult bone, and one inch and three-quarters behind, extends downwards, at an angle of nearly one hundred and thirty-five degrees, with the shaft of the bone below. The shaft is continued upwards beyond the origin of the neck, into the trochanter major, which is slightly curved inwards, forming a convexity towards the skin. The trochanter reaches to a level of within half an inch of the upper surface of the head of the bone, and is a little higher posteriorly, towards the sacrum, than in front. Erom the centre of the head to the centre of the trochanter, is two inches and a half. From the centre of the anterior superior spine of the ilium, to the middle of the trochanter major, in the normal condition of the joint while at rest, is four inches and a half. The trochanter should project beyond the anterior superior spine in a transverse direction, to the extent of about one inch and three quarters. The centre of the obturator foramen is two inches from the centre of the head of the bone. If the head were forced in this direction, but a little obliquely upwards, it would lie on the body of the os pubis, and an inch lower, on the descending ramus. The distance from the centre of the bone, when in its socket, to the tuberosity of the ilium, is three inches and a half. That from the posterior margin of the acetabulum to the edge of the ischiatic notch, is one inch and a half.

Position of the head in reference to surrounding objects.

The articulation comprises a strong fibrous capsule, arising from the periosteum around the acetabulum, of considerable thickness on the upper and outer side, which is lost generally on the intertrochantral lines below.

The ligamentum teres connects the head to the margins of the notch in the acetabulum. Its office is to control extreme abduction of the limb.* The joint is invested on all sides very closely with muscles. The rectus, and psoas and iliacus descend in front, the two latter muscles passing down to the trochanter minor; by the gluteus minimus on the outer side, by the pectinæus on the inner side, and posteriorly by the obturator internus, gemelli, tendon of the obturator externus, and quadratus muscles. Between the head of the bone, when felt in the groin, and the skin, we have the femoral fasciæ, viz., the superficial fascia, consisting more or less of fat, and the fascia lata, the rectus, and psoas muscles, and the fibrous capsule. The femoral artery lies on its inner side, but still upon the psoas muscle, and the vein yet more internally, on the pectinæus.

**Four dislocations described.**

The head of the femur is said to be the subject of four dislocations, which I give in the order of frequency, noted in the circle of my own observation; but there are differences of opinion on this subject: first, that upwards on the dorsum ilii; second, that backwards on the ischiatic notch; third, that on the obturator foramen, and, fourth, that on the os pubis.

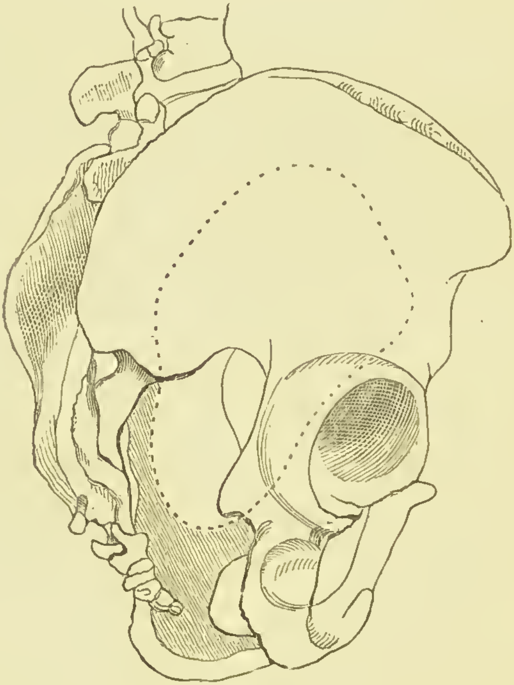
**No written description gives all varieties.**

Practically, I am persuaded that this division admits of large modifications, for we rarely find two cases of dislocated femur presenting exactly the same characters. To what cause can the differences in opinion on the position of the head of the bone, among men experienced in these accidents, be attributed, but to the varieties in its situation, and in that of the surrounding structures. It is very rarely that a dislocation of the femur bears out fairly all the written descriptions of authors. Not that these reports have been highly drawn or untruly recorded, but that cases vary in signs and manifestations, and hence the inapplicability of those rules which would restrict the liability to injury within certain anatomical limits. I remember, on one occasion, Mr. Abernethy, in his lecture on the hip-joint, laying it down as a rule, that a dislocation of the femur, on the dorsum ilii, in which the head of the bone is thrown *forwards*, could not take place. On the following day a boy was brought into the hospital, with dislocation on the dorsum ilii, and in which the head was *thrown distinctly forwards.* The boy had got up behind a hackney coach, and in descending, had thrust his leg between the spokes of the hind wheel, by which he had been carried round in one complete circle. The distance to which the head of the bone is carried away from the acetabulum in a dislocation, depends on the violence of the force applied, and hence the modifications I allude to.

---

* Mr. Luke is of opinion that it lessens the pressure of the acetabulum on the head of the femur in the vertical position of the body.

By the above division we exclude altogether by name a variety of dislocation of the femur, which is really of no infrequent occurrence, viz., dislocation on the dorsum acetabuli, and which is nowhere alluded to by authors; also, the fact is not generally stated, that the head of the bone may occupy the neutral ground *between* the surfaces of the acetabulum and ilium. In truth, observation has taught me that external force may displace the head of the femur in all directions, and in all degrees of distance from its socket; and that no man, who is not familiar with the



Distance of the head from socket dependent on degree of violence.

osteology of this region, can tell its exact position. Practically, I do not assert this knowledge to be so important as it may appear, for we do not necessarily qualify our remedial agents by the existence of these modifications, and yet we are hardly justified in recording the position of a bone, which is in fact untrue.

I have seen repeated examples of the following varieties —upwards, on the dorsum ilii, varying in distance from the socket from one to three inches; backwards, in the ischiatic notch, on a level with the socket, and an inch above its centre; on the dorsum acetabuli, both backwards, and upwards and backwards; inwards and slightly downwards over the obturator foramen; yet further inwards, on the ramus of the os pubis; inwards, and slightly upwards on the body of the os pubis, below the spine and transverse part of the bone; and straight upwards, nearly in front of the articulation.

Necessity of clear diagnosis.

Many of these are, doubtless, mere modifications of the division propounded by Sir Astley Cooper, and for all practical purposes that division may still prevail; yet it is obvious, by the most cursory glance at the bones, that the relation of the two extremities to each other, the degree of inversion, and the extent of retraction of the limb, must vary according to the position of the bone, and qualify, in no slight degree, the generally adopted opinions of the profession of the nature of the injury. Sir A. Cooper lays it down as a rule, that in dislocation of the head of the femur on the dorsum ilii, the foot of the dislocated side is thrown on the opposite instep. Now, if on examining a case, a surgeon of limited experience finds this relation of the extremities absent, if he be told to expect inversion of the limb to a certain extent, and there is little or no inversion, he may, not unreasonably, conclude that he has mistaken its entire nature. The fault would then justly attach to the writer, and not to the surgeon.

Cause of dislocation.

The cause of dislocation of the femur, is violence applied to the thigh or leg, generally by a severe fall, either from a height, or by any additional force given to the natural force of gravity. The general position of the bone, whether outwards or inwards, is determined, we may suppose, by that of the leg, at the moment of falling. If the leg meet the ground, or whatever firm object it comes first into contact with, while in a state of adduction, beyond the central line of the body, the outer part of the capsule is rent, and the head is driven upwards, or backwards, or both. This blow must strike the leg obliquely, for if it meet the limb in a straight direction, the force would be expended on the bone, instead of on the capsule of the joint. If, however, in the act of falling, the leg be abducted, the inner side of the capsule will be torn, and the head thrown inwards, or upwards and inwards. This is the most important division of dislocations of the femur, viz., into that outwards and inwards, the modifications of which into upwards and downwards depends, probably, on the angle formed by the femur with the trunk at the moment of the fall. If a blow strike the outer side of the knee when drawn forwards on the pelvis in flexion, the bone would be thrown backwards on to the dorsum acetabuli, or ischiatic notch ; if applied, however, when the thigh is in a state of extension, the head will be thrown upwards on the dorsum ilii. Now, as there is no apparent reason why the femur, in the act of falling, may not meet the obstacle at any intermediate angle with the body between flexion and extension; so it follows that the head may lie at any intermediate point, between the highest relation to the dorsum ilii, and the lowest, to the ischiatic notch ; and *it does lie in all.*

Cause of the varieties.

The same argument will apply in the opposite direction, as the cause of dislocation inwards, either on the obturator foramen, or on the descending ramus, or body of the os pubis. From the very nature of the accident, therefore, dislocation outwards must be a more frequent occurrence than that inwards.

Symptoms of dislocation on the dorsum ilii.

Supposing the head of the femur to be dislocated *on the dorsum ilii,* the case will present the following symptoms. The limb is shortened or retracted, to the extent of from one to three inches, by reason of the head being thrown higher than the socket; but the position of the head of the bone cannot be estimated by the shortening of the limb, which is slightly drawn forwards and somewhat bent at the knee. The limb is inverted in consequence of the head being thrown backwards. The degree of inversion cannot be learnt by examination of the skeleton. On the living body, the head and trochanter both rest on the gluteus medius and on the doubled up gluteus minimus, in what exact manner it is impossible to give any general description that shall be applicable to all cases; the trochanter lies within about two inches of the anterior superior spine of the ilium. The inversion, however, is not very great, nor is it easy to explain why it is not greater when the head of the femur is fairly carried up on to the dorsum ilii, except by reference to the muscles. The absence of the head from the acetabulum may be felt on firm pressure. The head and the trochanter are both very perceptible above the situation of the joint, and both may be made to revolve under the hand, by rotating the limb. The limb is fixed nearly in the longitudinal direction, and neither admits of flexion nor extension, abduction or adduction, without pain. Occasionally, but very rarely, an attempt to walk may be made. I recollect a case of dislocation on the ilium, in which a man walked a quarter of a mile to the hospital.

Dislocation on the ischiatic notch.

In dislocation into the lowest part of the *ischiatic notch*, the limb is not shortened at all, but it is placed more obliquely with regard to the trunk, and in consequence of the head of the bone finding a socket in that cavity, the inversion is inconsiderable; the acetabulum is hollow on pressure, the head is felt, though not so distinctly as in the former dislocation; the trochanter is prominent, and a little more freedom of movement is retained to the limb.

Cause of the indefinite nature of symptoms.

The diagnosis of dislocation of the head on any point between these two extremes, will be obtained by observing the degree of retraction and of inversion, by calculating the relation of the head to the socket, whether directly above, obliquely, or behind it, and by observing whether the head sinks deeply or not, and whether or not it is on the same level surface with the trochanter; for if thrown *slightly* backwards, it has not reached the ischiatic notch, but lies on the dorsum acetabuli. In all these modifications, inversion is a general symptom, in some degree or other, and the higher the head be thrown, the more positive will this symptom appear.

Dislocation inwards on obturator foramen.

In dislocation of the head on the *obturator foramen* or os pubis, the bone approaches the mesial line of the body. The different positions the head here occupies, are merely modifications of the two varieties of dislocation on the obturator foramen, and on the adjacent bone, for it may fall either on the middle of the foramen, or the descending ramus, or on the body or transverse ramus of the os pubis.

Symptoms.

When on the lower part of the obturator foramen, the limb is very slightly lengthened; but the measurement is rendered difficult by the relation of the thigh to the trunk, which is in a state of semi-flexion. This results from the necessary relief afforded to the tension of the psoas and iliacus, the action of which relates, not to the thigh, over the movements of which *they exercise little influence at any time*, but to the trunk, which is drawn forwards. Examined in the horizontal position, while in bed, the rectus is called into action, to effect the same end, by raising the thigh, and bending it on the pelvis, for the purpose of relieving the psoas and iliacus, now put on the stretch by the trochanter minor being carried downwards. In proportion as this symptom is well marked, the head of the bone may be supposed to lie low in the obturator region. As a general rule, the limb is everted; but the degree of eversion varies considerably, and cannot be relied on with any certainty, as an indication of the form of injury under consideration.

In dislocation upon the *obturator foramen*, the most striking external feature is the bent position of the trunk forwards, the toe consequently pointing to the ground; and flattening of the hip, from the inward position of the trochanter major, generally with more or less of eversion of the limb. Examined by manipulation, the limb will be found lengthened, but to an extent dependant on causes above described and accompanied with some slight power of being rotated inwards, and pain on attempting adduction. The head of the bone may be felt by close examination along the ramus of the ischium and pubes, but its distinctness will be in proportion as it is thrown more or less inwards. Add to these signs, the negative evidence derived from the fact of sudden violence, followed by loss of mobility, and the absence of the symptoms of dislocation of the bone on the dorsum ilii, or ischiatic foramen.*

---

* I have seen two cases of dislocation of the head of the femur on the upper part of the tuberosity of the ischium. In both the symptoms were obscure, and both were chronic. In one of them the rotation of

Dislocation on os pubis. Varieties of position.

In dislocation upon the *os pubis*, we find the same flattening of the trochanter, accompanied with more eversion of the leg. The projection of the head, on manipulating the region of the joint, will depend on its position. If low down on the body and ramus, it will be felt from the perineum, on firm pressure made on the gracilis and adductor brevis muscles ; if high on the body of the bone, lying in contact with the highest part of the origin of the adductor brevis, it will be distinctly seen above ; if on the horizontal part of the os pubis, and placed more outwards, towards, or even underneath, the vessels, it will be still more palpable on pressure, and the vessels may be felt passing over a rounded tumor ; and if still higher, when thrown above the bone, and in contact with Poupart's ligament, its position is very obvious both to sight and touch. In the latter case the eversion is great, the bone fixed, and the shortening equally positive.

Contrast with symptoms of fracture of neck.

Fracture of the neck of the thigh-bone is readily distinguished from any of the above forms of injury, by great eversion, joined to great mobility of the limb, by crepitus on extension ; generally by the more advanced age of the patient, and is often marked by ecchymosis about the joint, and is accompanied by the consciousness of the patient of having sustained a serious injury. In dislocations, a person will generally rise from the ground, and make an effort to walk ; in fracture, rarely, or never. With a clear idea of the exact nature of the accident, of which every feature has been carefully and repeatedly studied, the surgeon proceeds to the application of the reduction of the limb.

Principle and mode of reduction.

For this purpose he will require a narrow couch, or bed, strong staples for the opposite walls, or doorposts, a round towel in good condition, wash-leather, a sufficient quantity of good rope, and pulleys.

As the patient, while at rest, is suffering comparatively little inconvenience, the desirableness of an early attempt at reduction is no excuse for proceeding to the operation without having at hand all the requisite appliances for effecting it, or for doing that *well* that may be done *better;* and I cannot give more useful advice to any surgeon, not

the head of the bone was perceptible on pressure on the inner side of the tuber ; otherwise, the evidence was chiefly negative in its nature.

fully experienced in these difficulties, than that of urging him not to throw a chance away, as it is called, but to calculate his difficulties, and to make full provision against them; not to imagine the task an easy one, but to enter upon it with the conviction that all the resources of his art, and all his experience may be called into requisition.

Care in the disposition of means.

There is no objection to a superfluity of means, but every objection to an attempt, hastily and inadequately made, which may terminate in failure, either on the ground of want of power or from its imperfect disposition. The deliberate application of abundant resources is indispensable to success, wherever the dislocation of a large bone is under treatment. If the surgeon, therefore, would avoid discredit and self-reproach, let him adopt the best expedients at first, and not apply to their aid only when driven to them by the failure of secondary and inefficient power.

Counter-extension.

The patient should be laid, if possible, on a mattress, and placed on a low bedstead, and should be fully undressed to his shirt. Counter-extension, by means of a round towel, should be applied against the perineum. The towel should be brought round the ilium of the affected side, and its edges strongly sewn together, so as to spread over the ilium and abdomen, nearly as low as the trochanter. The other end should be carried upwards, along the back of the patient, and fixed either directly, or by means of a cord, to a staple driven into a rafter, or door-post, of the room. It is hardly necessary to mention that some care must be taken to avoid the genital organs. When the counter-extension is complete, the patient should be moved bodily downwards, to render that part of the apparatus tight.

Application of extending force.

Washleather, wetted in a fold of eight or ten thicknesses, should be applied round the ancle, and not above the knee, for reasons given in the introductory remarks on this subject. A piece of cord, of about two feet in length, should be carried across the middle of the sole of the foot, and passed upwards, along each side of the leg, and fixed on the washleather, by means of a second piece of cord encircling the leather two or three times, and tied firmly. The ends of the first cord may then be turned downwards, and tied at the sole. Thus we can effect uniform extension, from both sides of the leg. The two loops of the cord crossing the sole, which may be protected by lint, should then be drawn equally tight, and to these the extending cord should be applied, passed through the pulleys, and fixed to the opposite staple.

Direction of extending force.

The person of the patient should be inclined about a third of the half-circle round to the opposite side. The direction in which extension is to be made, depends on the nature of the dislocation, *i.e.* the position of the head of the bone. If on the dorsum ilii, the extension should be longitudinal, or nearly so. If backwards, on the dorsum acetabuli or ischiatic notch, the line should be more forwards. This variety in direction is not to be effected by the alteration of the line of the extending force, but by that of the attitude of the patient, whose trunk should be fixed forwards at the shoulders, not by curving the spine, but by raising him fully, so as to carry the line of the counter-extension further backwards, or at an angle of about forty-five degrees with the patient's back. The body should be retained at this angle across the bed, or at least across the extending power (if the bone be dislocated backwards), by a person sitting behind him, or by a broad bandage brought round his shoulders.

Line of extension perfect.

Slight extension should now be made, to see what direction the line will take when it is rendered more complete. Any error may yet be rectified, such as the galling of the extending agents, of the future extent of which, the patient may be able already to form some idea, and the line of extension and counter-extension must be ascertained to be perfectly straight. The extension may now be remitted, and chloroform administered to the full effect of unconsciousness, and it may be repeated throughout the attempt, if suffering be great.

Position of the surgeon.

The position of the surgeon is at the side of the patient, with his hand on the dislocated bone, from which, having satisfied himself that the apparatus is thoroughly well applied, he should not stir during the operation. If the dislocation be on the dorsum, the bone, under the influence of steady but slow extension, will descend in a straight line behind the acetabulum. When it has reached the lower level of the cavity, it is recommended to raise the limb, and suddenly rotate the shaft outwards, with a view to turn the head over the brim into the

Rotation of limb ineffectual.

socket. This effort may now be made, but I do not think it will be found to advance the case. If the head have descended sufficiently low, I believe it will enter the socket *without manipulation;* if it do not, extension should be continued, and slowly increased every two or three minutes. Supposing the patient to be under the influence of chloroform, a second attempt at rotation outwards is generally made. I believe it will be equally unsuccessful, and if so, and the head be perceptibly descending, the extending power should be continued, when the bone will pass, more or less audibly, into the acetabulum, at a moment, perhaps, immediately *following* the manipulative efforts of the surgeon.

In the three varieties of dislocation above given, whether on the dorsum ilii, dorsum acetabuli, or ischiatic notch, nearly the same management is required, with the one exception of the line of extension, which is subject to the modification I have mentioned.

Reduction in dislocation on obturator foramen.

In dislocation on the obturator foramen, if the patient be of moderate muscular development only, a good mode of proceeding is that of placing him against the lower part of a four-post bedstead, in the sitting posture. He should be fixed to the post by means of a sheet; a pillow should be placed between the post and his pelvis; extension should be made by at least three persons longitudinally, or very slightly across to the opposite side of the affected limb; the operation of which will resemble, in some respects, that of the heel in the axilla. Extension longitudinally should be fully made, before the direction be changed to the oblique line across, and this should be resorted to very sparingly.

On the pubis.

Should this plan be persisted in for fifteen or twenty minutes without success, the patient should be placed on a mattress, and the extending agents applied, as in the former dislocation, but with this difference, that the patient is placed on his back. In dislocation on the obturator foramen, the bone may be carried in a direction a little outwards: and in dislocation upwards on the os pubis, the pelvis may be raised before the extending agents are fixed, by solid cushions placed underneath it, to the height of about six or nine inches. Under either of these circumstances the line of extension will be such as to carry the bone sufficiently in the direction of the acetabulum to give it the best chance of reaching its cavity, by bringing it within the range of the co-operative action of its own muscles. Let me again urge the value of steady and patient persistence in moderate extension, and, more especially, in cases of difficult reduction. It is better to resort to an endurable effort for a longer period, than to attempt reduction by violent means, the result of which may be more or less injurious to the limb throughout life.

Simple extension alone required.

I have had many examples, both in reference to this and other dislocations, in which confidence in the restorative action of the muscles has always superseded the necessity of interference by lateral movements, rotation, &c., which are no less inapplicable to dislocation on the dorsum ilii with inversion of the limb, than to that I have last spoken of.

After reduction, a bandage may be tied loosely around the two knees, and the patient placed in bed. In a week or ten days, some motion may be allowed to the joint, which will have sufficiently recovered in the course of three or four weeks, to enable the person to resume any ordinary occupation. If the muscles were torn asunder, probably many more weeks' confinement would be required for this purpose.

## DISLOCATIONS AT THE KNEE-JOINT.—DISLOCATION OF THE PATELLA.

The dislocation of the patella may take place either outwards or inwards, but the former occurs almost invariably. This fact is due to its position, and to its relation to the muscles of the thigh, being placed at an angle formed in the course of the quadriceps extensors.

Remote cause of dislocation of patella.

The neck of the thigh bone is necessary to the existence of the large muscles on the inner side of the thigh, viz., the pectinæus and triceps adductor muscles, for without the neck, the two extremities would have been placed in contact, and descended in a straight line from the hip-joint. The existence of the neck demands obliquity in the shaft of the bone, and this obliquity creates an angle between it and the tibia below, which is parallel to its fellow. On this angle the patella is situated, which may be said to form a part of the quadriceps muscle, consisting of the rectus, cruræus, and two vasti, of which all above the patella is oblique, and all below, viz., the tendon, or ligamentum patellæ, is straight or parallel to the opposite tendon. If the quadriceps be put into sudden and uncontrolled action, with a force beyond the sustaining power of the fibrous and sinovial membranes of the inner side of the knee-joint, the patella will be drawn over the outer condyle of the femur, and dislocated.

Greater liability in women.

In women, having a broader pelvis, the liability to this injury is yet greater, and still more so, when the obliquity of the thigh bones inwards is combined with that of the tibia outwards, as in knock-kneed persons, in whom we find the severest cases of this kind.

Immediate cause of dislocation.

The causes of dislocation of the patella are chiefly muscular action, but are occasionally the result of external violence. Any muscle in the body may be the occasional subject of spasmodic contraction, in which it acts independently of its coadjutors. In the act of flexion, this condition of the quadriceps may be the cause of displacement of the patella, in persons having rather more than the ordinary obliquity of the femur, and dislocation outwards follows, in which the under surface of the patella lies in contact with the outer condyle. If the obliquity be great, the patella may be thrown partially or entirely over, on its back, with its cartilaginous surface upwards; but I have never seen but one example of complete reversion in the bone, and that occurred many years since, in the person of a knock-kneed dwarf, which was restored with great difficulty to its position.

Reversion of patella.

Dislocation inwards is always the result of external violence, and is generally accompanied by other forms of injury, such as fracture. A heavy weight falling on the knee, or a fall from a height may produce it. The joint may be extensively injured, and the patella fractured in any direction.

Symptoms.

The symptoms of dislocation of the patella are obvious. The bone lies on the outside of one condyle, instead of between them, and the movements of the limb are impaired though not destroyed. The patella is fixed, and has lost its easy lateral movements, while occupying its natural position, on the two condyles.

Reduction.

The principle of reduction consists in obtaining perfect relaxation of the muscles, which hold it in its false position; and this is effected by raising the thigh very high on the pelvis, and extending the leg, to relax the ligamentum patellæ. While the leg is forced upwards towards the vertical line, the surgeon should press the patella over the condyle, with such force as is required. This, however, is sometimes a difficult task, and requires persevering exertion to accomplish. The same object, viz., that of relaxing the quadriceps, will be answered by placing the patient upright in the sitting posture in bed, leaning a good deal forwards, however, and making slight elevation of the leg only. Under some circumstances this position may be more convenient than that usually resorted to. When reduced, the knee should be rolled lightly, and placed in a comfortable position in bed; or, if not rolled, the knee may be supported by a pillow, placed under it, by which a little permanent extension of the muscles and patella is insured.

Cases.

Within the last two months I have seen two cases, of what might not unreasonably be termed spontaneous dislocation of the patella. The first occurred in the person of a girl of about twenty, who found her patella dislocated, when she awoke in the morning, or was probably awoke by it. I have never seen a case of reduction so difficult of accomplishment as this. The girl was a patient of Mr. Stanley's, and on two occasions did the attempt to restore the bone baffle the best efforts of himself, and several assistants; on the third occasion, the bone was reduced with great difficulty, but immediately escaped from its position; again was replaced, and again escaped as before. Finally, the bone was retained. A week after this occurrence, I was sent to see a lady, who had just recovered from a confinement. She asserts that on waking from sleep, about three weeks afterwards, she found her patella dislocated; she was fully aware of its nature, having, on a former occasion, sustained the same injury. The bone was readily replaced, and a knee-cap ordered to be worn continually over the joint.

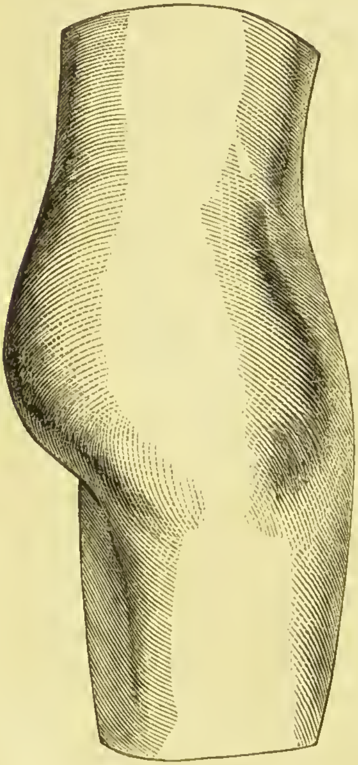
## DISLOCATION OF THE TIBIA.

Various dis-

The separation of the tibia from the condyles of the femur, is a rare accident, and can only be the effect of great violence from external causes. The tibia may be locations of tibia at the knee-joint.

Symptoms.

forced backwards, so that the condyles project in the front of the joint, either partially or entirely. The looseness of the skin and of the sinovial membrane is so great as to permit a considerable separation of the bones, without compound dislocation; yet even that accident occasionally comes within the range of hospital practice. The bone may also be dislocated forwards. We have partial displacement laterally, from falls or severe contusions, in which either condyle may occupy the situation of the other. The symptoms of either of these forms of injury must always be sufficiently apparent, if complete of its kind, and would be known, on comparing it with its fellow joint, by the irregularity of its form, and by the abnormal projection of the condyle, on the side opposite to that to which the tibia is carried; by the fixed position of the limb, which admits of neither flexion nor extension. Moreover, the line of the tibia is distorted from the knee downwards, especially in dislocation of the tibia backwards, where the bone appears to project forwards along its entire line. In these accidents the ligaments are less extensively lacerated than the apparent distortion of the joint would lead us to suspect, and particularly so in the partial dislocation, which consists in the twisted position of the tibia on the femur. If this twisted relation of the bone occur inwards, the crucial ligaments, or one of them, must be torn partially or entirely; whereas, when twisted outwards, these ligaments are merely separated from each other, or uncrossed.



From a cast in the Museum of Guy's Hospital.

Mode of reduction.

The simplest mode of reduction of all these forms of dislocation of the tibia at the knee-joint, is that of extension, accompanied by slight lateral motion of the joint, and pressure of the dislocated bone in the direction of the socket. It is very undesirable to make any attempt to bend the joint, until the extension is considerable, and has been continued for some minutes; and, generally speaking, the difficulty of reduction is not great. If the swelling be moderate only, a wet roller may be applied around the knee, and the limb placed in a straight position, and the application of a splint along the back of the limb, if there be any disposition to starting of the muscles, or spasm, is all that is required.

## DISLOCATION OF A SEMILUNAR CARTILAGE.

Form of joint little altered.

This accident is one of occasional occurrence, and its chief feature is severe pain in the situation of the dislocation. Sir A. Cooper refers it to the toe striking some unexpected object on the ground. I have never had the opportunity of verifying this opinion, though I have seen cases of the kind. The limb is placed straight; the knee not much distorted in its form. The inner cartilage is, of the two, the more subject to this accident; in which it would appear that the cartilage has escaped from its connections, and caught between the bones; and, on examining the joint, a slight fullness presents at the side of the knee, along the line of junction, between the condyle and the head of the tibia. The attempt to bend the joint creates severe pain, although it is slightly flexible by the agency of another person. Extension of the limb, and at the same time making moderate pressure with the hand on the opposite side of the joint, relieves the cartilage, which immediately resumes its natural position, and the pain suddenly ceases. After all these accidents about the knee-joint, the patient should wear some instrument which maintains pressure over the joint, such as a bandage or a knee-cap.

## DISLOCATION OF THE FOOT AT THE ANKLE-JOINT.

Structure of articulation.

The ankle-joint is a limited ginglimus, and is formed between the astragalus below, the tibia above, and its projecting process on the inner side, or malleolus; and externally, by the malleolus externus, formed by the fibula. Of the two malleoli, the external has considerably the larger surface entering into the structure of the ankle-joint. The tibia is fixed to the bones of the foot by an internal radiating ligament, which, descending from the malleolus, is attached extensively below to the astragalus, os calcis, and to the theca in front, that binds down the tendon of the tibialis posticus muscle. The external lateral ligament, descending from the fibula, is oblique from above, backwards and downwards, to the os calcis; and an anterior and posterior ligament, nearly horizontal in their direction, are attached to the astragulus. Behind the malleolus externus pass the two tendons of the peroneus longus and brevis; of which the longus passes forwards along the outside of the os calcis, enters a groove in the cuboid bone, and runs obliquely across the sole of the foot to the root of the great toe. The brevis is inserted into the metatarsal bone of the little toe. The action of these two muscles is that of turning the foot so as to direct the sole outwards. Behind the malleolus internus pass the tendons of the tibialis posticus and flexors of the toes, of which the flexor of the great toe passes through a groove in the under surface of the astragalus. The tendo Achillis, formed by the muscles of the calf, is inserted about one inch behind the tibia, into the extremity of the os calcis. In front of the joint past the tibialis anticus, descending to the os naviculare, and the extensors of the toes.

Varieties of dislocation.

The foot may be dislocated forwards, backwards, inwards, or outwards.

The separation of the bones may be partial or complete. In short, the ankle-joint is the subject of each variety, and every stage of each form of dislocation of the foot from the bones of the leg. Of these, the dislocation of the foot forwards on the tibia is, perhaps, the least common, and that outwards the most so.

Cause.

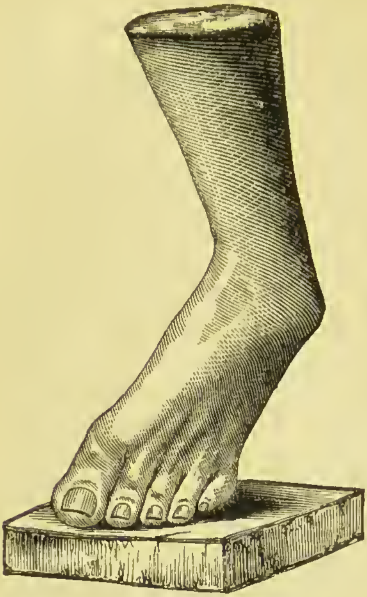
The cause of these injuries is usually a fall, or violence from a heavy body, but more commonly the former. It is difficult to obtain clear evidence on this head from patients; but we may conclude that each form of the above dislocation is the result of violence directed upon the foot in a line opposite to that in which the bone is thrown. For example, if in falling, either from a height, or with unusual force, the foot come into contact with the ground when drawn outwards, or should it meet with an obstacle, sloping inwards, in an oblique direction to the sole, the foot would be thrown out. But displacement may also result from the application of violence on the lower part of the tibia, while the foot is fixed on the ground in the horizontal position of the body, and placed vertically. I knew a case of dislocation of the foot backwards, occasioned by a heavy cask falling on the leg in this position; but almost invariably the force is applied to the foot, and not to the leg.

Effect on the joint in dislocation outwards.

In dislocation outwards, the foot is twisted, with the sole directed towards the fibular side of the leg. The internal lateral or radiated ligament is either stretched or lacerated, according as the dislocation is complete or incomplete. If incomplete, the astragalus, instead of being adapted to the fossa in the tibia, is thrown obliquely outwards, having its tibial surface directed to the malleolus internus, and the outer edge firmly fixed against the tibia. The external lateral ligaments remain entire, and the malleolus externus sustains the pressure of the bone outwards. The foot is more or less distorted in form, and is incapable of being either bent or extended. If complete, the internal lateral ligament is more extensively, or is completely rent asunder; the outer surface of the astragalus is in contact with the fossa of the tibia, and the force of the concussion, coming against the malleolus externus, breaks the fibula from two to three inches above the ankle-joint, forcing the lower piece of this bone in an almost horizontal direction outwards. The sole of the foot is directed outwards. This is occasionally known by the term of Mr. Pott's dislocation. If the flexor pollicis has not escaped from the groove in the astragalus, the great toe will be bent downwards, and extended not without pain or difficulty; and, indeed, the violence of the concussion may be in some degree gauged by this fact. The peronei muscles are relaxed by the position of the foot.

Dislocation inwards.

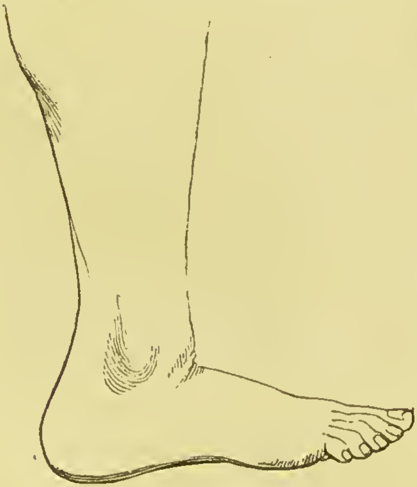
*In dislocation of the foot inwards*, its relation to the leg is apparent, if compared with the opposite leg; but its distortion is not so complete as in the last dislocation; the malleolus is occasionally, but not frequently, broken off. This dislocation is, I think, more frequently a partial one, than that outwards. The tendons of the peronei are tense, by reason of the elongation of their attachments, and the foot is fixed. A duplicature of integuments occasionally forms below the inner malleolus. The upper surface of the foot slopes outwards. The external ligaments are stretched or torn.



From a cast in the Museum of the Royal College of Surgeons.

Partial or complete.

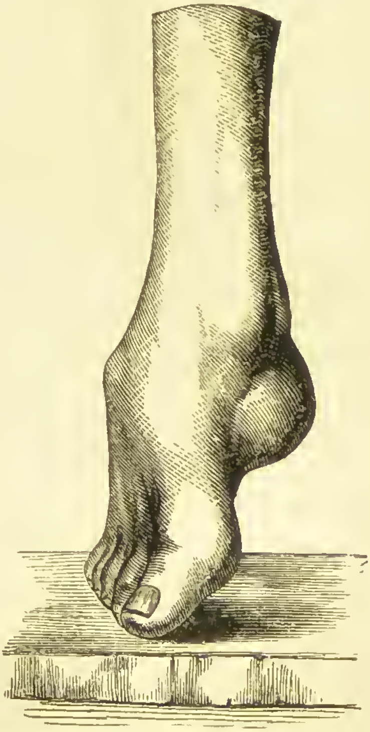
*In dislocation of the foot backwards*, the astragalus is thrown out of the fossa, either partially or entirely. If partially, the force has been inadequate to a total rupture of the lateral ligaments, and the two articular surfaces are still in contact, but in an abnormal relation to each other. If complete, the tibia lies forwards, across the foot, upon the navicular and cuboid bones. The length of the upper articular surface of the astragalus is about an inch and a half; and a fair judgment of the extent of the dislocation may be formed by the admeasurement, taking the distance from the centre of the malleolus internus, to the extreme surface of the heel. The lateral ligaments, if not entirely torn asunder, must be partially severed, and the position retained by the remaining fibres. The distance from the front of the tibia to the toes is unnaturally short; and that from its back, to the heel proportionately long. The lower part of the



tendo achillis appears to pass obliquely backwards, instead of vertically, to the os calcis. There is often a fold of integument at the inner ankle. The foot is fixed, but, as is the case, perhaps generally, in these dislocations, is less firmly fixed in partial than in complete displacement of the bones.

Dislocation of the foot forwards.

*Dislocation of the foot forwards* from the tibia is a more rare form of accident than that last described. It may be so partial in degree, as to raise a reasonable doubt of its existence; but it may be known by the approach, closer than natural, of the heel to the posterior surface of the tibia, by the length of the foot in front of the bone, and by the fixed condition of the joint. Yet I have seen two cases in which the opinions of experienced men were in opposition as to the presence of dislocation, so slight was the displacement.

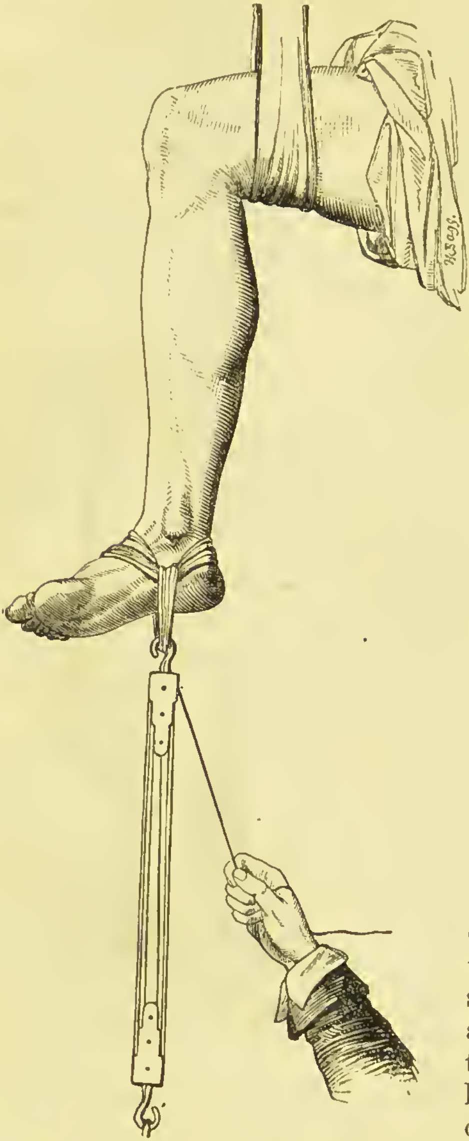


Symptoms.

In complete, or nearly complete dislocation forwards, we have little difficulty in forming an opinion. It is only in incomplete forms of injury that the difficulty prevails. Comparison with the opposite foot, the previous normal condition of the limb, the evidence of an accident, will establish the fact of an injury sustained; negatively, the absence of fracture, of dislocation either backwards, inwards, or outwards; and positively, the proximity of the heel, the length of the front of the foot, and its fixed state ought to lead to the only one conclusion, viz., that the foot is thrown forwards from the articulation. In lateral dislocation the foot presents more or less a twisted appearance, but not so, when in the direction forwards or backwards.

Mode of reduction.

The reduction of all these forms of dislocation is effected by the application of the same principle so frequently urged, viz., extension. The joint is so firmly fixed, both by muscles and by ligaments, that any attempt to reduce the dislocated bone by the hand will prove nugatory. The pulleys should always be resorted to, so great is the strength of the agents of retention, whatever they may be. Nor have I ever failed in the application of the following method.



The patient should be placed on the dislocated side, and his knee bent at a right angle. Around the lower six inches of the thigh, a broad and strong bandage should be applied, the two ends of which should be carried upwards, in the line of the leg, and fastened to a staple in the wall. The ankle should be encircled by a strong coarse roller, of about six or eight thicknesses, which should be applied wet, and very loose, between which and the leg a second roller, doubled, should be passed on both sides, and round the sole, and tied. When extension is made on the wet roller around the ankle, it will be drawn below the malleoli, but will not admit the passage, through the circle thus formed, of the os calcis. The rope and extending pullies are applied to the second roller, and extension is then commenced. The surgeon standing at the foot, close to the side of the cord, which may pass through his legs, takes the foot in front, and also at the heel, in his two hands; and when the extending force has been applied for a few minutes, he draws the foot in the opposite direction to that of the dislocation. If dislocated either outwards or inwards, it will probably return to its natural position without any manipulation; if forwards, or backwards, the foot should be played a little in the action of flexion and extension on the tibia. The extending power should be persisted in for ten minutes, or somewhat longer, but if the apparatus be well applied, and the extension considerable, I have found a period of five minutes suffice to reduce any one of the above forms of dislocation. After the reduction, a wet roller should be placed around the joint and cold applied, if it exhibit any tendency to swell.

After the reduction of dislocation of the foot outwards, with fracture of the fibula, some care should be bestowed on the position of the foot in bed, otherwise, as Mr. Pott has remarked, the peronei will tend to draw the foot outwards, in consequence of the fractured fibula failing in its natural support to the outer surface of the astragalus. The leg and foot may be, however, safely placed on the outer side, supported on a well padded splint, and with the addition of the foot being raised, by directing the sole slightly upwards. I can bear no personal testimony to the liabilities first announced to the profession by Mr. Pott, never having witnessed them, although mechanically, the anatomy of the parts involved would point to their occurrence as not improbable.

## DISLOCATION OF THE ASTRAGALUS.

The astragalus, although fixed below to the middle of the os calcis by a very strong interosseous ligament, and to each malleolus by the lateral ligaments, and by a dorsal ligament to the navicular bone, is occasionally the subject of dislocation, even, indeed, to the extent of its complete reversion.

**Form of dislocation.**

It may be thrown upwards and inwards, and upwards and outwards, depending on the direction of the force applied. It has also been thrown inwards in front of the malleolus internus. A not unlikely cause of this injury is one recorded by Dupuytren, in which a person alighted from a height on his heel, when the astragalus was thrown forwards on the navicular bone. Although the astragalus may be the occasional subject of single dislocation, I am not convinced that every case recorded by authors were cases of this kind, so generally is this injury complicated with the displacement, either partial or complete, of other bones of the foot. When simple displacement has occurred, the relation of the remaining bones to the tibia is undisturbed; the astragalus, whether thrust forwards, outwards, or inwards, being jammed in between the tibia, calcaneum, and navicular bones; but if the sole be directed outwards or inwards, and if the relation of the entire foot to the tibia be altered, so that the distance between that bone and the tendo Achillis be either lengthened or shortened, the case would assume the form of dislocation of the foot, to which that of the astragalus from the foot is superadded.

Reduction difficult.

The difficulty of reduction is, perhaps, increased, rather than otherwise, if the case be that of simple dislocation, for the bone in its new position is so indistinct in form and relation, that it is impossible to ascertain the precise obstacle to its return; and excision of the bone is the not infrequent resort of the surgeon, nor do I know any other alternative, when the bone is reversed, excepting that of trusting to nature's disposition to reconstruct or remodel the joint, which, in the case of a young person would not be improbable.

The attempt at reduction should be made by fixing the leg as in the former dislocation, tying a clove hitch of cord over a roller, applied around the foot, behind the metatarsal bone of the little toe; while the foot is drawn downwards at the toes, and at the heel, the astragalus should be pressed backwards with force. If this fail, the foot should be drawn *forwards.* The obstructing tendon or tendons may be divided without serious damage, if there be reasonable ground for this operation.

Division of obstructing parts.

The consequences either of leaving the bone in its abnormal position, after violent attempts have been unsuccessfully made to reduce it, or that of excision of the bone, are sufficiently formidable in their result to justify any reasonable attempt to replace it. Among other measures that may be resorted to, is the division of the ligaments, and especially the internal plantar, or calcaneo-navicular ligament; and considerable space would thus be afforded by which to reduce the bone to its natural position. Of course, it should be a subcutaneous operation. When divided, the foot may be forced a good deal outwards, and space probably allowed for the return of the bone.

Division of ligaments.

The same principles will apply to dislocation of either of the remaining tarsal bones, the reduction of which is far more easily affected. With respect to dislocations of the metatarsal bones and phalanges of the toes, they have no distinguishing feature to render it necessary to resort to agents different from those applied to the reduction of dislocations of the upper extremity.

## DISLOCATION OF NASAL CARTILAGES.

Among other kinds of dislocation, that of the nasal cartilages should not pass unnoticed. We have two cartilages on either side of the nose, the upper one attached to the extremities of the ossa nasi and superior maxillary bones, and a second elliptical piece forms the aperture of each nostril, while the septum nasi, occupying the centre, forms the partition between them. A violent blow may displace any of these cartilages from the ossa nasi, and from the nasal process of the superior maxillary bones, and flatten the nose to the level of the nasal bones; or by still greater violence, fracture these bones, or separate them from the frontal. The nature of the injury can scarcely be mistaken, although the knowledge of its full extent requires examination. The evil will be somewhat increased if the dislocation be a compound one, and if much of the cartilages or bone be exposed. The future appearance of the individual will depend on the greater or less care bestowed on the reduction. The nose is so important an organ of the face, and on which its character so much depends, that its restoration is of no ordinary moment, and should engage the best efforts of the surgeon. After a careful examination, and the parts cleansed of blood, the little finger should be oiled and passed up the nostril as high as possible, for the purpose

Extent of injury.

Careful replacement necessary.

Nose moulded into the best form.

of prizing up the broken bone or bones, whether nasal or maxillary, for both are occasionally fractured. As it is impossible to effect much benefit by the ordinary principle of extension, the organ should be moulded by the finger, the bones first replaced, and then the cartilages upon them. If the nostril be small, the scoop end of a director may be employed for this purpose. The contour of the nose should be preserved as much as possible ; and, as happened on one occasion in my own practice, should even be improved on the original outline if possible. If the fracture be comminuted, the cavity may be filled with cotton wool, or even by some firmer material, which will give support to the nasal bones, while lateral pressure is made on the external surface, by nicely adjusted lint and plaster. Any wounds of the skin should be very carefully united by fine sutures.

## DISLOCATIONS WITH FRACTURE.

Varieties of compound injury.

The descriptions hitherto given in this chapter, relate almost exclusively to the dislocations of the respective bones from their articular cavities, in their unbroken state ; but dislocation, accompanied by a fracture of the dislocated bone, is no unusual accident, and presents difficulties to the surgeon of a very formidable kind. Of these, the most common are fractures with dislocation of the head of the humerus ; fracture of the ulna, or radius, or both, with dislocation of one or both bones ; fracture of the lower end of the radius, with dislocation of the carpal bones and hand ; fracture of the condyles of the femur, with dislocation of the patella ; and fracture of the lower end of the tibia or fibula, with dislocation of the foot. The difficulty may be still further complicated by the compound nature of the injury by which the joint is more or less exposed to view. This difficulty consists in the impossibility of influencing the dislocated portion of the bone by extension, provided the separation be complete.

Relations of muscles.

As a general rule, the fractures alluded to take place between the head of the bone and the muscles acting on it from above ; for example, that of the head of the humerus separates the head more or less obliquely from the shaft, above the attachments of the pectoralis major and latissimus dorsi, but not above the scapular muscles, viz., the supra spinatus, infra spinatus, teres minor, and subscapularis. In the elbow-joint, the brachialis anticus and triceps are inserted into their respective bones, closely in contact with the joint, whereas, in all the remaining examples, the insertion of the muscles is farther down the bone. If the end of the broken bone be insulated, it is quite obvious that any form of extension will be unavailable. If the head of the humerus be the seat of the injury, it is probable that it yet retains its connection to some, if not to all the muscles inserted into the tubercles, although it be totally separated from the shaft of the bone below.

Every device employed in reduction.

The first indication points to the restoration of the dislocated bone. To accomplish this, the most strenuous efforts should be made, by the employment of every reasonable device that the knowledge and experience of the surgeon can command. Although we cannot command the movements of the head of the bone, we can, at least, influence the position of the glenoid cavity, which should be forcibly directed towards the head of the bone. However, all will probably prove unavailing. The next question arises, what is best to be done in order to restore the limb to the most serviceable condition in future? Is it preferable to leave the bone untouched, and trust to nature to restore it to future utility, as in the case of ununited fracture, in which the muscles have adapted their actions to the necessity of their position; or to attempt the union of the fractured surfaces, with the probable attendant evil of permanent dislocation? There can be no doubt that the latter course is that which offers the fewest objections, and its adoption is not incompatible with perfect recovery. With this view the two surfaces should, if possible, be brought into close contact, and the limb kept at perfect rest, however peculiar the position, or the means employed to effect it. Should the bones unite, which is most probable, unless unfortunately any of the soft structures around should intervene, nature will form a joint to suit its movements. Imperfect, indeed, in its construction, when compared with the original joint, but susceptible of extensive and serviceable movements, notwithstanding. Here then the case may rest, provided the patient be satisfied with the condition of the limb. This, indeed, will depend in some measure on his station

Unite the bones.

Reduction attempted after union.

of life. When the bone is firmly united, or at the expiration of six or seven weeks for the humerus, and five or six weeks for the radius and ulna, an attempt may be cautiously made to move the head from its attachments; and should this succeed, the application of a well regulated extending force, which should rely on the efficacy of time, rather than of power, may succeed in restoring the joint to its healthy condition.

The above remarks apply to injury of the shoulder and elbow-joints. In the examples of the same accident befalling either the knee, wrist, or ancle, the same extent of difficulty does not prevail. If the injury be so great as to preclude a hope of restoration of the joint, nothing remains for us but to place the limb in such a position as will meet the most important services to which it may be hereafter called.

Separation of epiphyses.

It is important to recollect, in reference to fractures in the neighbourhood of joints, the liability to separation of the epiphyses in young persons. Such accidents occur about the shoulder-joint, by the disjunction of the epiphysis of the humerus at the elbow, by that of the olecranon or coronoid process of the ulna, or of the articular extremity of the humerus, and at the wrist, by the separation of the articular extremity of the radius. The same accident may happen to the femur at the knee-joint, or to the tibia at the ancle.

Separation of epiphyses frequent in children.

The separation of the epiphysis from a young bone is effected with a less degree of violence than is required to break the shaft of the same bone; and should such fracture occur in the neighbourhood of a joint, in children below twelve or fourteen years of age, in a line corresponding with that of the epiphysis, it may generally be presumed that the apparent fracture consists in a separation of this process. Practically, it is not very important, because the treatment would not differ from a fracture of the same line of bone after union is completed between the epiphysis and the shaft. Less time, however, would be required to repair the injury in the younger subject.

# CHAPTER V.

## ON BANDAGES.

VALUE OF BANDAGES TO THE SURGEON — IMPORTANCE OF ACQUIRING SKILL IN THE APPLICATION — USES OF A BANDAGE — MODE OF APPLICATION — THE COMMON BANDAGE — THE T BANDAGE — THE FOUR-TAILED BANDAGE—THE MANY-TAILED BANDAGE.

In the following brief chapter is included a description of the four or five forms of bandage in most common use, with a general reference to the kind of malady in which their services are employed.

In no department of surgery is the improvement, which has of late years taken place, more strikingly exemplified than in this ; and it is a fact well worthy of observation, that, as we advance in scientific knowledge, so have elaborate and complicated contrivances gradually yielded to the simple bandage, now almost exclusively employed. This application, properly made, answers, with some few exceptions, every useful purpose, although skill and ingenuity may occasionally be required, to meet the demands of individual cases.

The simple kinds of bandage most serviceable.

The common bandage consists of a strip of strong unbleached calico, without seam or selvage, varying from one to ten, or twelve yards in length, and in width from one to five, or six inches. It is firmly rolled up for use, and hence is commonly called a *roller*. Sometimes linen or flannel is the material employed, the latter being selected for the sake of additional warmth.* Elastic bandages, made either of a fabric like stocking material, or of India-rubber web especially, are also often employed with great advantage.

Uses of a bandage.

Bandages are applied for various surgical purposes, viz., to protect a diseased part from injury—to confine dressings, &c. in their situation—to restrain movement—to assist union where a solution of continuity has occurred—to support parts in a state of debility—to retain hæmorrhage by compression—to oppose certain displacements of the viscera, and to prevent or rectify deformity, by holding the dislocated parts in a natural relation to each other.

---

* It should always be borne in mind that when the common bandage is wetted, it becomes tense, but relaxes again on drying.

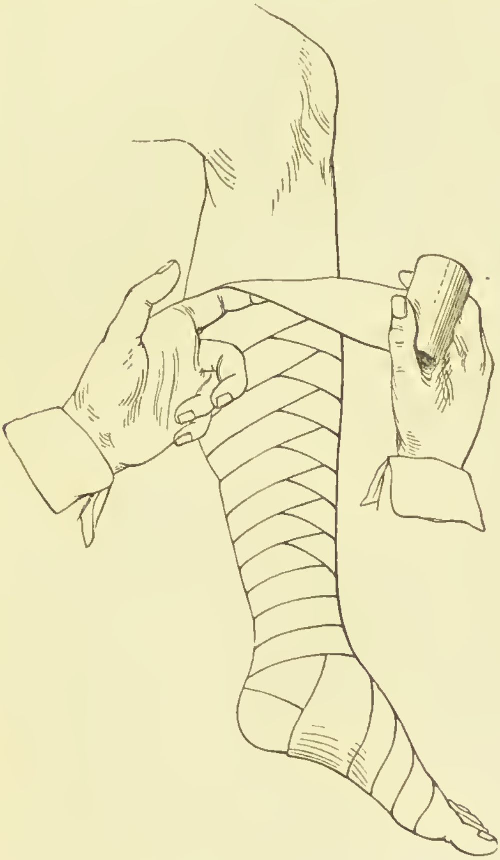
Skill in their application to be acquired only by practice.

Skill in the application of a bandage is not to be acquired by any description. It can only be obtained by frequent practice: and I would earnestly advise every student to lose no opportunity of becoming a thorough proficient in this department of his profession. It is a subject which, in relation to its importance, is neglected, I believe, beyond all others. A bandage is not successfully applied with the facility imagined by those unpractised in the resort to it. Many surgeons, who can perform a capital operation not without eclât, find great difficulty in the application of a simple bandage, and execute this really important part of their duty most imperfectly. Such an exhibition presents a warning and a useful lesson to all around. There is no excuse for the neglect of this subsidiary art; the opportunities for practice are always abundant; there is every motive for the acquisition of skill, and its possession is a duty we are all liable to be called upon constantly to exhibit.

The common examples in which the use of bandages is required are, cases of ulcers, varicose veins, or other affections of the leg, and fracture. It is impossible to enter into detail, but when once the art of bandaging is acquired, it is very easy to meet the demands of each individual case. The general object is to apply the bandage smoothly and evenly, to ensure an equable pressure on the surface beneath, and to employ no more than is sufficient for the required purpose. If parts are liable to swell, allowance must be made for the difference of size. These ends are best attained by commencing at the extremity, and applying the bandage most tightly in that situation, and gradually and almost imperceptibly remitting the pressure as we ascend; the roller should be kept close to the surface, and not more of it unrolled than is necessary; each successive fold should overlap about one-third, or one-half of the preceding. In order to apply the bandage smoothly to parts of unequal diameter, we double it upon itself. We will take one example by way of illustration.

Adaptation of common bandage to varying diameter.

Suppose it is necessary to apply a bandage to the leg in a case of varicose veins. We commence by placing the extremity of the bandage on the dorsum of the foot, and surround the metatarsus by a few turns; the roller being passed from one hand to the other, the bandage is then carried up obliquely across the tarsus from within outwards, round the ancle, and back again. It is better to carry the bandage up on the inner side of the instep, in order to support the arch of the foot. This manœuvre is again repeated, care being taken to enclose as much of the heel as possible, and the bandage is then rolled spirally up the limb. As the leg increases in diameter the roller is to be reversed, or folded sharply over on itself, guided by the finger. (*See* plate.) The bandage is continued in this manner up the leg, as far as is required, usually to a point immediately below or above the knee; a few circular



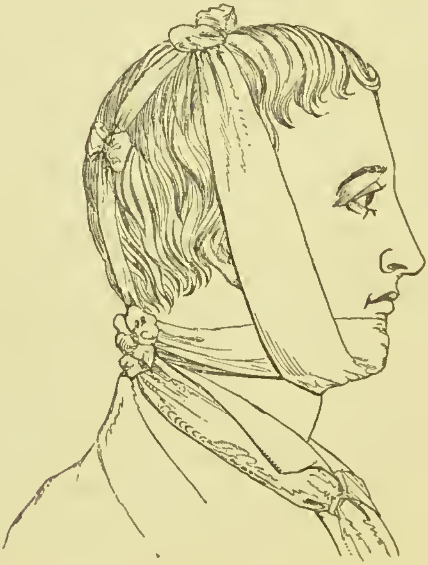
turns are then given, and the end fixed either by a pin, a few stitches, a piece of adhesive plaster, or by splitting the end of the bandage longitudinally for a short distance, bringing the ends round the opposite sides of the limb, and tying them together. A bandage well applied has a very neat appearance; it lies smoothly, the lower margin of each fold is seen at equal distances, at which the inflections are placed. These inflections are generally made over that part of the limb requiring the greatest pressure.

The T bandage.

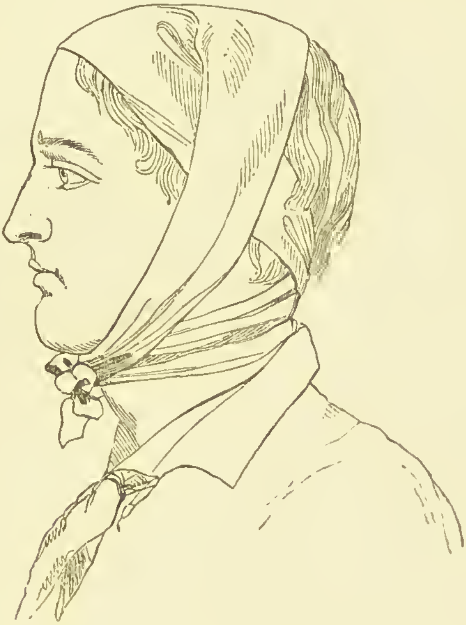
The T bandage is sometimes employed for giving support to the anus, perinæum, scrotum, &c. It consists of a circular portion of considerable breadth, which passes round the loins, and a perpendicular piece, which descends from the back, passes between the thighs, and then ascends to be fixed in front. The circular portion may be supported by means of bands passing over the shoulders. The perpendicular portion may be provided with a pad, covered with oiled silk and split longitudinally in front, &c., according to the necessities of each case, each end being drawn over the corresponding groin.

The four-tailed bandage.

The four-tailed bandage is a very useful contrivance. It is generally employed in fractures of the lower jaw.



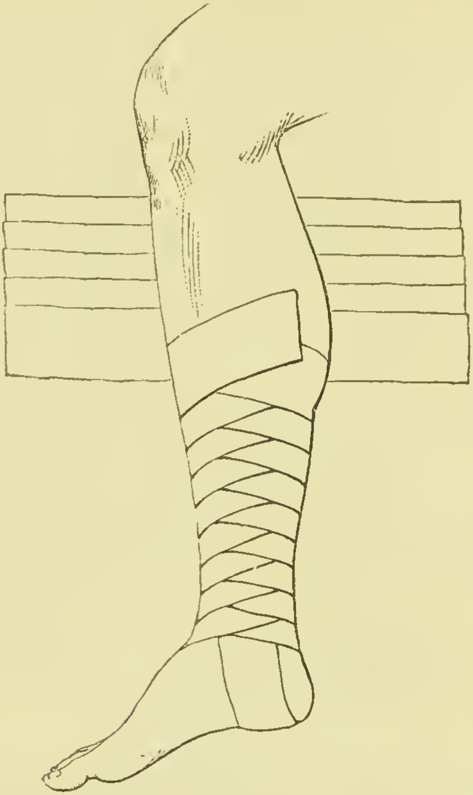
This is required for keeping dressings on the head, knee, &c. It consists of an oblong piece of calico or linen of requisite size, split up the middle, at each end, nearly to the centre. If applied to the head, the middle portion is placed towards either the front or back, according to circumstances; the anterior ends are brought backwards under the occiput, and either tied there, or brought round the neck and secured in front, the posterior are



fastened under the chin. Its mode of application to the jaw, or other parts, is obtained by reversing the above position, viz., by applying the central broad part to the chin, around which it is made to fit, by carrying two ends, vertically, to the summit of the head, and the other two backwards round the occiput. These ends are then united to each other by a vertical piece.

The many-tailed bandage.

The many-tailed bandage is sometimes, though rarely, employed in cases of fracture of the leg. It consists of a longitudinal portion, and a sufficient number of transverse pieces, proportioned in length to the circumference of the part to which it is to be applied. The transverse pieces are laid across the longitudinal portion, a little obliquely, each somewhat overlapping the one above, and fixed by a few stitches; the limb is laid upon the longitudinal strip, and each pair of the ends are necessarily brought across in front of the limb, commencing with the lowest.



Additional information on this subject is given elsewhere.—*See* Fracture, Dislocation, Hernia, &c.

# CHAPTER VI.

## ON FRACTURES.

NEGLECT OF TREATMENT OF FRACTURES BY BRITISH SURGEONS — INDUSTRY REQUISITE RATHER THAN SKILL — SIMPLE FRACTURES — COMPOUND FRACTURES — COMMINUTED FRACTURES — TRANSVERSE, OBLIQUE, LONGITUDINAL FRACTURES — CAUSES OF FRACTURE — INFLUENCE OF THE MUSCLES ON THE POSITION AND RELATIONS OF THE BONES — OVERLAPPING OF THE BONES, AND SHORTENING OF THE LIMB — SYMPTOMS OF FRACTURE — CREPITUS — PRINCIPLES OF TREATMENT — REDUCTION AND RETENTION — COMPOUND FRACTURES — IMPORTANCE OF EARLY PROGNOSIS — TRAUMATIC FEVERS — SLOUGHING — FRACTURES INTO JOINTS — ANCHYLOSIS — FRACTURES WITH DISLOCATION — SPECIAL FRACTURES — RE-UNION OF BONES.

Neglect of this branch of surgery.

A CHAPTER on the subject of fractures of bone, although rarely calling for the employment of the knife, or other instruments of surgical cutlery, involves both the principles and the manipulative agency of operative surgery. It has been charged against British surgery, and not without some show of reason, that its powers, which are so largely and so successfully wielded in the cause of other diseases, have been more sparingly dealt out in the cause of a broken bone, than of any other structure. This charge, if true, implies less the want of knowledge, than the want of industry. The management of simple fractures claims less of professional skill, than of time and labour. The principles are both obvious and simple, and in the award of responsibility between the powers of nature and of art, it must be confessed that nature performs by far the greater half of the duties required.

Any part of the skeleton is liable to fracture—cranium, ribs, sternum, vertebræ, pelvis, extremities. This liability is of daily occurrence. Experience is acquired, more especially in towns and in largely populated districts, without difficulty. Every surgeon ought to be familiar with such knowledge; and, considering the healthy condition of the entire osseous system as indispensable to a man's functions in life, almost whatever duties are assigned to him, he ought to be equally prepared to take the trouble requisite for its complete restoration, in case of any ordinary accident befalling it. More than ordinary care is required in cases of fracture of the extremities, involving joints, for example, in oblique fractures in persons of peculiarly irritable habits, and in severe compound fractures; but, in reference to simple fractures, whether of the trunk or extremities, and without idiosyncracy, a small amount of knowledge, with a moderate share of personal exertion, are all the requisites demanded for their complete restoration.

Industry required, rather than knowledge.

But, however perfect may be the resources, and however large the contribution of nature to the union of a broken bone, these resources are profitless, unless directed and controlled by art. Bones are structures of comparatively so low an organisation, as to influence the sensibilities of the constitution in a very slight degree, so long as the bone alone is broken. The health is little disturbed; neither inflammation nor suppurative action interrupt the simple process of union, up to its final consummation. The chief source of evil is derived from the necessary restraint incidental to the treatment. One is, therefore, at a loss to find any apology for those surgeons to whose want of care, and even of humanity, may be attributed the numerous examples of distorted and contracted members, which have cast a reproach on the surgery of Great Britain. It is not in the management of great cases that the superiority of the surgeon is so strongly manifested, as in that of common diseases of every day's occurrence. Genius for our art may shine out on great occasions, and brilliant devices contend against remarkable deviations from health; but *conduct* is required by us all. The word *conduct* has a wide interpretation—it appeals to the application of the humanities of life, as well as to the exercise of skill and industry in the application of our best resources to the treatment of disease.

Importance of conduct.

Simple fractures.

Fractures are various in kind, and each kind claims some important modification in its management. Perhaps the most important division of this form of injury is that into simple and compound; but each variety is subject to modifications. *Simple* fractures, usually affecting the extremities, or the ribs, may occur in different relations to the affected bone. A bone may be broken transversely or obliquely, or almost longitudinally. The shaft of the bone may be merely divided by a transverse or oblique section, or it may be broken into many fragments. Thus we have a *comminuted* fracture. The case is further complicated by the greater or less injury done to the soft structures around it. A *compound* fracture is defined to be a solution in the continuity of a bone, accompanied by an external wound, which communicates with the fractured bone. This communication almost necessarily infers a greater extent of injury done to the soft structures of the limb than in simple fracture ; and it is not therefore surprising that so much greater difficulty attends the future progress of the case. But the exception to this general rule is not very uncommon, because a fracture may be greatly comminuted as regards the bone, and very destructive of the soft parts ; and yet the skin being unbroken, brings it within the definition of a simple fracture ; and on the other hand, a cutaneous bone, like the tibia or ulna, may, when fractured, be partially forced through the skin, with little injury to the soft structures of the limb, and still obey the definition of a compound fracture.

**Definition of compound fracture.**

The causes of fracture, which, though usually direct, may indirectly affect a bone at a distance, are almost invariably referable to external violence, such as a blow or fall ; but it is indubitable that the sudden and violent action of the muscles attached to a bone is occasionally the cause of its fracture. Indeed fractures of the patella are almost uniformly attributable to this cause alone, and occasionally also that of the olecranon. But although a fracture of a long bone by the action of its muscles is a rare accident, we meet with daily examples of the agency of this power in displacing bones that are already fractured, and, indeed, of converting a simple into a compound fracture. If the humerus be broken immediately below the coraco-brachialis, or the radius below the insertion of the biceps muscle, the sudden action of those muscles must almost necessarily exercise an influence on the position of that fragment of the bone into which they are inserted. But the influence thus exerted by these and similar muscles, must be contemporaneous with the moment of fracture ; for nothing can be more improbable than that these muscles should continue for

**Causes of fractures.**

an indefinite time to increase the distortion of the broken bone. In cases of fracture, whether transverse or oblique, the bone is generally shortened in its length by the action of the muscles inserted into it; but this change takes place at the time of the accident; and so long as the limb is at rest, the shortening does not increase, even to the lapse of some hours before it is placed in splints. There is a vast difference between the extent of the action of muscles exerted on any given bone in dislocation and in fracture, as may be inferred from the different degrees of force required to replace the bone in the two forms of accident; for the one is readily effected by the extending power of two persons, and retained by the simple application of splints, while the other requires the artificial force of the compound pulley. While I admit the efficacy of muscular contraction in shortening a fractured limb, I cannot concur with the authors of the old school of surgery, in the belief that the direction taken by the lower fragment is attributable to the operation of this cause. The relation of the lower fragment to the shaft is greatly determined by the direction of the blow. If the femur be broken half way down by violence applied on the outer side of the limb, in all probability the lower end will overlap the upper, and project on the inner side of the thigh. But this retraction is produced at the instant of the shock, by the sudden action of the muscles exerted for the purpose of steadying the limb, and not by their continued action after it. The resistance afforded by a large bone or a large limb, is sufficient to control these actions after the accident, in a great degree. Indeed the pain which their action would produce, would of itself insure sufficient control to prevent further contraction. Not so, however, in the case of a large muscle attached to a small bone, as we find in the example of the patella drawn up by the rectus muscle, and the action of which often continues for some days after the accident.

Direction of overlapping not caused by muscles.

The retraction of the limb is always produced by this contractility of the muscles, and hence the overlapping of one bone by the other. The projection of one or more bones at the point of fracture may be occasionally due to the action of the muscles operating on the upper portion, but not so commonly as is supposed. In the case of the

Retraction dependant on muscles.

thigh, for example, the long muscles of the limb have lost their influence by reason of the solution in the continuity of the bone, on which they have hitherto acted; and of the muscles connected to the upper half, we have the triceps, which may act by distorting the line of the bone in the direction upwards and inwards, while in the examples of fracture of the femur immediately, or to the extent of some inches, below the trochanter minor, the upper fragment is drawn forwards by the now reversed action of the psoas and iliacus muscles. It will be recollected that the rectus in front passes beyond the fracture, and the cruræus and vasti arise from the upper portion of the femur, and cannot therefore influence its movements, while the flexors behind the bone extend below the fracture to form the hamstrings, and can, of course, only operate on the lower portion. With respect to the humerus, we may have the deltoid or the coraco brachialis acting on the bone in the direction of their origins, in cases of fractures below the insertions; or the muscles of the axilla, in fracture still higher up on the bone; but I do not think that the projection of the upper portion of the humerus is materially influenced by their actions, which is rather to be attributed to the direction in which the force has been applied against the bone. In the case of fracture of the radius, again, we have only the pronator teres, the action of which would be immediately expended in the act of rotating the fore-arm. It has no power of elevating the upper portion of the bone. That the muscles exert some influence is highly probable, but I think not to the extent that has been supposed.

Relation of the bone caused by direction of external force.

The shortening of the limb in fractures, is, without doubt, owing to the action of the muscles immediately consequent on the accident; but I contend that this violent action does not continue, as in the case of a dislocation, and I doubt very much whether it is the uniform cause of the prominence of the upper end, so frequently found; the truth of which observation will, I think, be confirmed, by observing more critically than is usually done, the relation held by the surrounding muscles to the upper or projecting portion of the bone.

Although fractures are more frequently the result of external violence than of any other cause, yet a bone may be broken by the sudden arrest of its movements, as has occurred by placing the foot in a plug-hole, while in the act of walking. Such fractures are almost invariably oblique, while the transverse fracture is generally the product of a blow from a small body, as distinguished from the crushing effects of a large one.

Symptoms of fracture.

The *symptoms of fracture* are generally unequivocal. In cases in which the ends of the bones are separated, it is characterised by pain, by shortening, by a powerless condition of the limb, by irregularity in its form, and by the sensation produced on friction of the broken ends of the bone, termed crepitus. Some of these symptoms occur in dislocation, but in fracture the injury, unless in the neighbourhood of a joint, is palpably referred to the shaft. Shortening of the thigh is common to both fracture and dislocation; but in fracture, the part is more distorted from its usual form than in dislocation, and the pain caused by the attempt to move it is referred to the shaft, and not to the joint, and should the fracture occur within a few inches of a joint, the crepitus will determine the nature of the injury without difficulty, because the bones are thick, and cannot so well overlap each other, as in the case of fracture of the shaft, in which the two rugged surfaces may be brought into contact without difficulty.

Crepitus.

The crepitus, which not infrequently attends on cases of dislocation, is distinct in its character from the crepitus of fracture. An experienced touch will generally detect the one from the other readily enough. *False* crepitus is caused by the friction of two rough surfaces, composed of soft material; *true* crepitus, of hard bone. False crepitus gives merely a slight jerk to the rotatory movement of the bone, while true crepitus conveys a sense of hard grating, perceptible both to the surgeon and the patient. Pain almost invariably attends the effort which causes crepitus in fracture, and the evidence of the injury being once clearly obtained, and it can only be obtained in many cases by a considerable effort, the surgeon should desist from its repetition. It is only in cases of doubt that the patient should be subjected to the certain evidence of violent and painful rotation. There are positive evils attendant on the occasional presence of a superfluous array of surgeons, all of whom, animated by an earnest love of professional knowledge, are naturally and commendably enough unwilling to allow an oppor-

Painful and to be avoided.

tunity to pass without improving it! Should it be necessary, for the benefit of the patient, that crepitus be felt, it may generally be rendered palpable by the slightest and the gentlest movement of the limb, when the bones are previously extended. Of course much will depend on the limb broken, not only because the bone is more or less covered with muscles, the presence of which will necessarily mask the sensation, and render it less distinct, but because, in the case of the thigh for example, the limb is large and bulky, and is handled with more difficulty.

Oblique fracture.

When a bone is broken, the muscles of the limb, taking advantage of the loss of the extending agency of the bone, draw up the lower portion, and hence shortening. The power the muscles exercise in thus reducing the length of the limb is greatly increased, if the fracture be oblique, and the ends pointed; and in proportion to the obliquity of the fracture and the power of the muscles is the difficulty of retaining the two surfaces of the bone in permanent contact, when brought into apposition, because the obliquity of the lower end acts like a wedge, and in persons of very irritable habit, the activity of the muscles is by no means confined to the moment of the fracture, but calls for the unceasing watchfulness of the surgeon throughout the early period of the treatment. In oblique fracture, crepitus is more readily perceptible, without elongating the limb, than in transverse fracture. If the bone be comminuted, it will be still more distinct, or at least the sensation will be attainable with a still less effort of rotation. The pressure of the splints, acting laterally through the body of the limb, often contends but imperfectly against the tendency of the bone to retract, in consequence of the wedge-shaped form of the lower end of the bone, which forces its way upwards in spite of them. In fractures of a single bone of the fore-arm and leg, composed as they are of two bones, and especially if without displacement, the difficulty of diagnosis is often very great, and that of the fibula especially, for we have neither shortening nor distortion, nor crepitus. In such cases, fortunately, treatment by splints is not so necessary as in fractures of single bones, sufficient extension being kept up by the other bone.

Two indications, reduction and retention.

Splints.

Fractures of nearly all the bones, and particularly of the extremities, present two distinct indications: first, the replacing or reducing the fracture, and, secondly, the retaining it in a suitable position for permanent union. The first end is attained by extension of the limb, and for this purpose the surgeon should have sufficient, and more than sufficient power at his command. Having made an examination of the limb, both by the eye and by the hand; having ascertained, by the exercise of his best judgment, the locality, and the direction of the fracture, whether transverse or oblique, and whether comminuted or not, his next step is to provide the means by which to retain it in position. For this purpose, either wooden or metal splints are employed. Observing the form of the limb, he will determine the number to be applied, taking care that as much of the surface be covered by the splints as possible, in order that, being extensive, a less degree of pressure is requisite; but that they do not "ride," as it is termed, over each other. If any considerable space be left between them, it will be compressed by the straps or roller applied around the splints, and create inconvenience, and even pain. The splints, however, should not be too wide or bulky. A round limb may require four in number; whereas for the fore-arm and leg, we can conveniently adapt but two. The limb is protected against the injurious consequences of the splints by pads, and much of the future comfort of the patient depends on their being efficiently made. They should be arranged by the surgeon himself, or under his immediate direction.

Construction of pads.

The material usually employed for this purpose is tow or cotton wool. If the former be selected, it is necessary that it be new and fine, and free from balls. Mr. Abernethy, who made the best pads I have ever seen, and who took the trouble to instruct me in this necessary art, used to have the linen in which the tow was to be inclosed laid out, and he then drew the tow from the mass in detail, by the pressure of the inner side of his hand against the table, from one end of the pad to the other. This process he continued till the whole mass so disposed, had reached a sufficient thickness. It was then inclosed in numerous folds of the linen and sewn up. Pads are not usually made of sufficient thickness to protect the skin against the pressure of the splints, and particularly so at the ends, where the hard substance is likely to irritate and inflame the structure against which it presses. Cotton wool is also a good material; and, indeed, in some respects, is preferable to flax, being softer, and at the same time more elastic. The cotton used in wadding for dresses, is objectionable. Horsehair and bran are also occasionally employed for the purpose; but every end is answered by the two first-named agents, which, indeed, are more generally resorted to.

Linen bandage not generally required.

It is the custom of some surgeons of the present day to retain the old practice of applying a linen bandage, in some form or other, immediately around the limb, previous to the application of the splints. Some surround the limb with a common roller, others apply the old eighteen-tailed bandage, which is, in my opinion, a superfluous appendage in the treatment of fracture, and may be perfectly well represented by a piece of fine linen applied once or twice around the limb, extending to the breadth of a foot or more. As a general rule, both may be dispensed with. The splints should be retained by straps and buckles, instead of pieces of calico roller. The degree of tension effected by the straps can be more easily regulated. The straps, whether of thin leather or of tape should be broad, and the buckles strong and well and firmly attached to them.

Extension and counter extension.

When this apparatus is completed, the fracture should be "*set.*" For this purpose the limb, suppose in the case of a fractured thigh, should be drawn out in extension by one or two persons of competent strength, employing force, steadily and uniformly made, on the extremity. The limb may be drawn from the knee or from the ankle. The counter-extension having the weight of the body in addition, requires, of course, less power. While the extension is being made, the surgeon stands by the side and assists, by gentle movements of his hands, in mould- the bone. He may, with this object, slightly raise the fractured bone and draw it in all directions, while extension is being made, and employ pressure with his hands, first on one side and then on the other. The extension should be continued for some minutes, until the thigh has reached the entire length of the opposite one; but the extension should be continued, although with less force, while the splints are being applied, and, indeed, up to the moment of their being fixed by the straps. Deficient extension of fractured limbs is a common fault; if made with caution and with gentleness, it can hardly be carried too far. When the splints are properly applied, it is of little moment in what position the limb is placed; but in the case of the thigh, if the trunk be horizontal in bed, the thigh should be a little raised to the ham, and the knee may be slightly bent.

The functions of the body, during the treatment, demand observance by the surgeon; the action of the bowels will be arrested by position, by inactivity, and by the shock to the nervous system. This condition of temporary torpor will recover itself in the course of thirty-six or forty-eight hours, and if not, it may be assisted by the mildest form of aperients. Little medicine is required of any kind.

Removal of splints.

The period at which the splints should be first removed, depends on circumstances. So long as we have ocular evidence that the length of the bone corresponds with that of the opposite limb, so long as the patient has no cause of complaint from the unequal pressure of the splints, but lies easy in bed, in the possession both of appetite and of sleep, we have no excuse for their early removal. It is the practice of some surgeons to indulge what appears an idle curiosity, by removing the splints almost daily. There can be no warrant for this practice, so long as the parts are undisturbed, and free from pain. At least five or six days, even a week or longer, may be allowed to elapse before the limb is examined, when the upper splint should be carefully removed, and as carefully replaced, if all appears progressing well. If, however, the limb be again shortened, and the bones appear to over-lap, the splints should be removed, and extension repeated as at first, additional care being taken in their readjustment: should the first examination prove satisfactory, the splints should not be removed for at least another week, or ten days.

It is the practice of the French school, and recommended by Dupuytren, to remove the splints on the day after the accident, in order to ascertain that the position of the bone is satisfactory, and that gangrene of the limb has not taken place. No doubt, gangrene has occurred in rare cases on the day after fracture, but that fact forms no solid ground for the removal of the splints on the second day in all. The liability to gangrene may be pretty well ascertained by the degree of injury which the soft parts have sustained before putting up the limb. In cases in which extensive injury of the soft parts has occurred, it is necessary to examine the limb, not only on the day following, but on any and every subsequent day; but this occasional liability cannot, surely, subject all fractures to the same necessity.

Gangrene.

When the limb appears contused, and indeed under almost every variety of circumstance, it is desirable to increase the tension of the straps which encircle the limb, after the first day or two; or, in other words, it is desirable to apply a moderate degree of pressure only in the first instance.

Permanent extension.

When an oblique fracture occurs in a person of irritable habit, who lies restless in bed, obeying very imperfectly the instructions of the surgeon, as regards quietude, it often happens that every care bestowed, fails to retain the bone in its position. Under these circumstances we are compelled to resort to some artificial mode of maintaining permanent extension of the limb; or what is preferable, the counteracting force, in the case of fractured thigh, may be enlarged by the application of a long splint, used by the late Mr. Liston,* which passes from the axilla to the foot, and is attached around the abdomen, perineum, thigh, and leg. The instrument invented by Mr. Bottomley is an improvement upon it.

Means of effecting permanent extension.

Permanent extension has been occasionally resorted to, by means of a weight hanging over pulleys, but it is difficult to regulate, and is a source of continued restraint. The object may be better attained by two, or even three, steel springs, each end of which is let into a socket, formed in a firm belt, applied at the extremities of the fractured bone. One should be applied around the thigh, immediately below the groin, and the other close above the knee; and the springs, which should be about an inch in breadth, and operating with a force of some six or eight pounds, bent, and introduced into the sockets made to receive them. This extension, which need not be very great, is permanent, and has the advantage of being unaffected by the movements of the body. It is, perhaps, hardly necessary to say, that the springs should be applied during the full degree of extension of the limb.

---

* Originally invented by Baron Boyer.

An improvement on the spring is that of an instrument, which makes extension permanent, by the tension of a strap on the principle by which we elongate an ellipse by the application of lateral pressure on its sides. By tightening the strap we increase the extending power.

When the shortening of the bone with overlapping results from spasm of the muscles, occurring within a day or two of the accident, this principle of permanent extension is not applicable to the case. The evil must be met by constitutional treatment and careful watching.

Contused limb.

In cases of large contusion, in which blood is extravasated, the splints should at first be loosely applied to the limb, for otherwise their pressure will be a source of mischief. If the extravasation be very great, it will be better to postpone the application of splints altogether for a few days, and either to resort to the long splints or to permanent extension by means of the instrument I have above described. This treatment is especially required in injury of the soft parts, likely to lead to disorganization. The surface may vesicate and become gangrenous, under which circumstances, of course, the presence of splints would greatly aggravate the evil.

Position of limb.

With regard to position, much has been said by Pott and by many subsequent writers, the greater part of which resolves itself into the necessity of avoiding any undue strain on the muscles. If the leg be placed in a straight line, the flexors of the leg are in an attitude of less ease, than if the thigh were a little bent; and by placing the limb in the position of semiflexion, we obviate the liability to spasm of the muscles involved. This principle is a good one, when practicable, and should be strictly observed.

Compound fractures.

The treatment of compound fractures demands all the art of the highest classed surgery, whether relating to their local or to their constitutional management. In simple fractures, the attendant evils are immediate and slight in degree; in compound fractures, the present symptoms are severe, and are yet more so, in prospect.

Local inflammation, extensive suppuration, and possibly gangrene, are accompanied by the various forms of severe traumatic fever, assuming the characters of hectic and typhus. In severe cases, the constitutional forces are reduced to the lowest ebb, the powers of life are exhausted, and under circumstances of peculiar difficulty, the question of amputation is often raised. This condition infers a probable fault in the management of the case on the part of the surgeon:—either an error in judgment at the outset, a miscalculation as regards the extent of the injury done, excess of confidence in the constitutional powers of the patient, or mismanagement of the case during the treatment. Had other treatment been adopted, the limb might have been saved, or his life not been jeopardised. But this condition is by no means necessarily a subject for self-reproach. The best judgment is fallible; the best experience but an onward step in knowledge. It is the sacred duty of a surgeon to avoid amputation, if possible, at the time of the accident. If the injury to the soft parts be not very great; if the bone do not largely protrude, nor the skin be extensively lacerated; if the continued warmth of the limb below the fracture indicate the escape of the main artery, and the nerves be not implicated, the attempt should be made to save the limb: but, on the other hand, very extensive laceration of the muscles, particularly if accompanied by separation of the skin, or a large protrusion of the bone, and especially, if reduced vitality, indicated by loss of warmth and sensibility of the extremity below the fracture, point to injury of the vascular and nervous systems, then amputation is the best alternative to the attempt to retain the limb. There are, in the whole range of surgical practice, no cases requiring more deliberate and sound calculation than these cases of compound fracture, in which the injury is just so considerable as to raise the question of removal, without giving a definite answer to it. Having considered this subject more in detail, under the head of amputation, I proceed to the treatment of compound fracture.

Degree of injury justifying amputation.

In compound fracture of the thigh, which I again imagine the example, we employ either the long or the interrupted splint, which latter instrument is so termed because it connects the two portions of the splint sawn

Reduction.

asunder, by an arch of iron, in order to leave the wound open for local treatment, and to protect it from the pressure of the entire splint. The bones should be reduced by slow and careful extension, and adjusted by the lateral movement of the limb, described in "simple fracture," and the wound be carefully brought together, and, if possible, healed by the application of plaster.

rotruded one.

Supposing the bone to protrude through the muscles and skin, and to be so firmly fixed as to preclude the possibility of its reduction by any force of modified extension, lateral movement, &c., what is to be done? Whether to remove the protruded bone by the saw, or to enlarge the wound. If we attempt the former expedient, we not only endanger the skin, but in removing the portion which protrudes, we may leave the cause untouched; for the bone may be held by the muscles within, as well as by the skin; and, indeed, in order to detach it from the skin which encircles it, the bone must be forced out yet further through the wound, and if the entire shaft of the bone be removed, we preclude the chance of recovery without permanent lameness, for the bone is shortened by so much as has been removed. The great difficulty often found in detaching the bone from its position, is commonly due to its relation not to the muscles, but to the skin alone. When we recollect the degree of force by which it has been protruded through the integument, the elastic nature of the integument itself, and the difficulty of applying a counteracting force on the real seat of the constriction, we cannot be surprised at the frequent failure of our efforts. The bone is tightly girt by the skin, and moves with it simply because we have no means of applying extension on the skin, and counter-extension on the bone alone, the force being applied to the entire limb. The better treatment, generally, is that of enlarging the wound with a knife, and, if necessary, the division should extend even through the offending muscles.

Enlarge the wound.

The question of making a wound through sound skin is essentially distinct from that of enlarging a wound already made by the addition of a clean incision, and, therefore, to that course we are generally driven.

The bone being reduced, the limb is to be "put up" with more than usual care, the edges of the wound carefully brought into apposition, and the bone retained by the long splint. If by the "interrupted splint," it should occupy the aspect of the limb on which the wound is placed, and the limb placed over a slightly inclined plane, that is, raised from the groin to the knee, and then as slightly bent downwards towards the heel. The length of the part of the plane which supports the thigh, should correspond with that of the thigh it supports. If too long, it will drag on the knee, and inevitably distort the lower fragment of the bone below the fracture; if too short, it will be useless. And this is the great objection to the double inclined beds, invented by my late friend Mr. Earle. Unless the bed fit the body with some approach to accuracy, the entire of the femur will not lie flat upon it, and the consequence is, that the lower fragment, especially if the fracture occur in the neighbourhood of the knee-joint, will ride upwards, and leave a lump or swelling, caused by the inapposition of the two surfaces. To possess the full advantages of this generally excellent invention, the pelvis should rest entirely in the hollow formed by the angle; but instead of this, the pelvis of many patients, occupying beds too short for their height, rests across the angle, instead of in it, in consequence of the leverage caused by fixing the feet to the board, the leg being the lever, and the ham the fulcrum.

**Uniform support necessary.**

The recovery from a compound fracture, in all cases of severe injury to the soft parts, is necessarily slow, for deep-seated inflammation follows, and, more or less suppuration continues for many days or weeks. If the wound heal permanently, for it may unite and the edges again separate, the process of suppuration will either not form at all, or will be very limited in degree. Under such circumstances, the progress of the case towards recovery will be less tardy. If the wound do not unite, but on the contrary, if it show marks of inflammation around it, it is obvious that the case must progress through suppurative action. Here all the powers of the constitution are required to carry the patient through the depressing influence of the disease; and then is it that we begin to feel the pernicious results of early depletion, vainly employed to prevent consequences inevitable to

**Recovery necessarily slow.**

**Early depletion injurious.**

the great extent of injury the parts have sustained. The fever, in the first stage, assumes the character of the simple inflammatory kind, gradually changes with the change of the local symptoms to that of hectic, in which a large secretion of pus, and general relaxation of the ordinary secretions draw rapidly on the vital powers. All this time no process of reparation has commenced in or about the bone. The period occupied in simple fracture in uniting the bone, is here engaged in repairing the injury done to the soft parts, and not until this reparation is complete, or, at least, not until diseased actions have subsided, does this process commence. In proportion to the condition of tonic health of the person, are the later stages manageable. To reduce the strength in the first stage of the injury, by copious venæsection or by purgation, is almost sufficient to ensure the occurrence of a train of subsequent symptoms, which jeopardises the life of the individual. In my opinion, no principle can be more false, no practice more pernicious. In compound fracture, the vital powers should be sedulously nursed from the commencement, and local irritation allayed, if possible, by absolute rest, and the employment of any form of application that is soothing and agreeable, no matter what character or form it may assume.

Fractures into joints.

The case is complicated, if the fracture extend into a neighbouring joint, and especially so, if the joint be a large and an important one, like the knee. If the bone be at all comminuted it cannot be expected that the joint will be saved; anchylosis is the almost certain issue. But it by no means follows, that anchlyosis should be the result of a simple fracture of a bone extending into a joint, particularly if the fracture be slight. Still, under all circumstances in which this form of accident occurs, it is right that we be prepared for the possible loss of the articulation, by placing the limb in such a position as may render it hereafter most serviceable to its owner.

Position in anchylosis all important.

For example, in fractures into the elbow-joint, although possibly at other times desirable, the straight position would prove a very objectionable one. We should bend the joint so as to bring the fore-arm at an angle of about one hundred and ten degrees with the upper arm, this being the position which experience proves as the most generally useful. In the case of a fracture of the lower end of the femur, or the head of the tibia, extending into the knee-joint, the leg should be very slightly bent on the thigh during the treatment; and so under all circumstances in which the structure of the joint may become disorganized, the utility of the limb should be duly considered, supposing the joint to be destroyed.

**Passive motion.**

The worst consequences of fractures extending into or involving a joint may be sometimes avoided by the adoption of *passive motion* as soon as the union is tolerably firm. That is to say, at the expiration of a month or so, the joint should be cautiously moved from time to time by the surgeon.

**Fracture with dislocation.**

In fractures combined with dislocation, the difficulty in the treatment is greatly increased. Of the two evils, that of fracture is obviously the greater. It is quite impracticable to reduce the dislocation unless we have an entire bone to draw upon, for the extension of the muscles, even though justifiable, could never lead to the reduction of the bone; and the bone being broken, no extension from below can reach it, supposing the fracture to occupy its upper third, or even as low as its middle, or, indeed, under any circumstances, would it be possible to apply the agents of extension with benefit. In this condition of the limb, the course to be pursued is to reduce the fracture as though unaccompanied with dislocation, and having obtained union of the bone, then to attempt reduction of the dislocation. The bone will be united, probably, at the expiration of five or six weeks, and the dislocation may be reduced by judicious management, even to a later period. (*See* DISLOCATIONS.)

**Starched bandage.**

The application of a starched bandage, after union of bones, is very desirable, and, indeed, becomes necessary, should the limb be called into employment before the union is perfectly firm; and it will afford great support and a sense of security that is highly valued by any patient who is compelled by necessity to move about prematurely. The bandage should, of course, be applied when wet, with the patient at rest, in which state he should continue until the bandage, having become dry, has acquired sufficient stiffness to effect the object.

**White of egg, &c.**

White of egg, with flour or with whitening is occasionally substituted for the starch.

**Bending of**

The bones of young children are susceptible of being bones in childhood.

bent when the force is insufficient to produce fracture. This bending is, however, often accompanied with some degree of fracture on the convexity, constituting the form of injury known as the *green-stick fracture.* We observe this change of form produced in the clavicle, fore-arm, and even in the thigh and bones of the leg. Such an effort of violence cannot be obtained without injury to the organization of the bone, and it should be treated like ordinary fracture, in the reliance on the resources of nature to replace and remodel the bone, under the influence of simple pressure.

## FRACTURE OF THE LOWER JAW.

Fractures of the lower jaw may occur in the vertical or in the transverse direction, but are far more frequent in the former. They almost invariably arise from a blow, by which the bone may be broken, in any part from the symphysis to the ramus. The evidence on examination is generally conclusive. The separation of the bone is for the most part slight, and is often imperceptible without manual examination. The simplest application is often the best, a piece of linen of three feet long, and about six to nine inches in breadth, will make an excellent bandage for the occasion, if torn from each end to within five or six inches of the middle. (*See* Bandages.) A small circle should be cut out for the reception of the chin. Two ends are then tied behind the neck, and the posterior two are carried upwards and fixed over the head. Should this fail to keep the bones in apposition, a mould of the jaw may be made in gutta percha or pasteboard, wetted in hot water. This mould, fixed on to the jaw, will harden in a few hours, and should be retained by the above bandage. Sometimes it is necessary in vertical fracture, to tie two or more teeth together with a metallic thread, and with the view of facilitating the introduction of food, which must be necessarily liquid for some time, it is a good plan to insert a portion of cork or something similar between the jaws. The vertical fracture requires the application of the agents of retention, whatever they may be, for an average of twenty-five to thirty days. If transverse, somewhat longer.

## FRACTURE OF THE RIBS.

Fracture of the ribs is the result of a blow directed against the chest. If by a pointed instrument, a single rib will be broken; if by an obtuse force, probably two, or more. Whatever be the form of the immediate agent of the injury, the force must be applied suddenly, or the elastic support of the rib would protect it, at least from fracture.

Fracture at the angle.

A rib is usually broken at, or near its angle, that is, about three or four inches from its attachment to the spine, because it is here that the two forces, viz., that of the blow and that of recoil from the spine meet, although the blow may have been received at some distance forwards. This part of the rib being covered with large muscles, explains the difficulty which so frequently attends the detection of the injury. The symptoms by which it is ascertained, are local pain on pressure over the suspected region, and crepitus. But this latter symptom cannot be perceived without a force of pressure that is exceedingly painful, so much so, indeed, as often to preclude any prolonged examination.

A broken rib is brought into coaptation on the same principle on which other fractures are reduced, viz., by extension. This object is attained by making a full inspiration, and by distending the lung to its largest dimensions. By this means the extremities of the rib are elongated, and the fractured ends are brought into apposition. The apposition should be maintained by means of an elastic bandage applied around the chest, which, while it retains the bones in contact, permits, at the same time, a freedom of respiration which is rendered difficult, and indeed impossible, under the agency of common calico or even flannel, care should be taken not unnecessarily to involve the walls of the abdomen in the pressure. Emphysema consequent on larceration of the lung, is not an infrequent occurrence, but its presence does not contraindicate ordinary treatment by pressure. A rib will usually unite in from twenty to twenty-five days.

Elastic pressure preferable.

## FRACTURE OF THE CLAVICLE.

With the exception of the radius, the clavicle is more frequently broken than any other bone. This fracture is generally caused by a point-blank fall on the shoulder, by which either the collar-bone is fractured or dislocated. It is, however, a far more frequent accident than dislocation, which is very rare. The symptoms are generally distinct and unequivocal.

Symptoms. 1. The line of the bone is interrupted, the inner portion being raised. This irregularity is ascertained by passing the hand along it. 2. The head is often drawn a little to the affected side, to relax the sterno-mastoid muscle. 3. The shoulder, having lost the radius of its movements, approaches the mesial line of the body, compressing the axillary cavity. 4. None of the muscles attached to the bone can be brought into full action. Displacement, however, is not the invariable attendant on fracture of the collar-bone. When the fracture occurs at the distance of about an inch from the acromial end, or between the two portions of the coraco-clavicular ligaments, these ligaments, acting on the bone above, prevent their separation, and fracture is then detected with more than usual difficulty. Fracture of this bone is not uncommon in young infants.

Fracture without displacement.

Treatment. The treatment of fracture of the clavicle involves extension of the bone, and adjustment of the broken ends. This is effected, as in dislocation, by drawing the shoulders backwards, while the knee is applied against the middle of the back, and retaining them by the figure of 8, or Brasdor's bandage. If this method fail, the arm should be extended outwards. Care should be taken to protect the axilla by pads, which, with the bandage, will require reapplication nearly every day. A large pad should be put into the axilla, if there be any tendency in the bones to overlap, and the fore-arm supported by a well-adjusted sling. A month will be required for the union of the bone.

## FRACTURE OF THE SCAPULA.

Fracture of the body of the scapula is exceedingly rare, consequent on the mobility of the bone on the trunk, to which it is connected by little more than muscle. A severe blow on the bone, by which it is struck against the ribs, may, however, break it in any direction, whether vertically, obliquely, or transversely. The acromion process may be fractured distinctly from the rest of the bone. The neck of the bone may be partially or entirely separated from the body, and the coracoid process may also be broken singly; but all these fractures are rare. If crepitus be not perceptible, the knowledge of fracture may be obtained by negative evidence. If the clavicle be sound, and the line of the acromion be uninterrupted, if the head of the humerus rotate without pain, *when extended or drawn from the socket*, if the fore-arm be bent without difficulty, or without the expression of suffering, and crepitus be still felt, the body of the bone must be broken.

**Negative evidence of fracture.**

Fracture of the coracoid process is an exceedingly rare accident. Pressure in the situation of this process, between the deltoid and pectoralis muscle, will when present detect it; and this evidence will derive confirmation from the painful action of the muscles arising from this process, viz., the pectoralis minor, coraco-brachialis, and biceps. If the pressure of the finger give no pain, and the biceps muscle can be put into action by bending the fore-arm, the coracoid process cannot be broken.

**Fractures of coracoid process and neck very rare.**

With regard to the neck of the scapula, the portion so called, would include the glenoid cavity and coracoid process as far as the notch. But a fracture of this extent is also very uncommon, although fracture of the neck of the scapula, like that of the coracoid process, is spoken of as of frequent occurrence, but I am persuaded it is far otherwise. Fracture of the glenoid cavity, however, is by no means rare. It is detected rather by negative than by positive evidence, but that evidence is generally very conclusive. A severe blow or fall on the shoulder is followed by distinct crepitus. The surgeon passes his finger along the collar-bone and acromion, extending to the spine; the patient bears pressure without flinching. The coracoid process is subjected to the same inquiry. There is thus far no evidence of fracture. The head of the humerus rotates under the hand without pain, while hanging at the side, and also during extension from the side. Nothing remains but the glenoid cavity and the neck, by which term I now refer to the connecting material merely, which unites the glenoid cavity to the body of the scapula. If the whole angle be broken, including the coracoid process, its extent would render it at once obvious; it is probable, therefore, and almost

Firm rotation against glenoid cavity.

certain, that the glenoid cavity itself, or what is more likely, that a part of it has separated. If in the act of rotating the arm the head of the bone be pressed somewhat firmly against the glenoid cavity, then a partial crepitus is felt, that expresses a fracture of a portion of that cavity only.

I attended a lady who was thrown violently from her horse on her back. She suffered severe pain in the region of the inferior angle of the scapula, which was attended by general swelling. In two or three days the movements of the arm were effected only with great suffering. On raising the arm gently, to some distance from the body and then rotating it, I felt crepitus at the inferior angle of the bone. I also detected crepitus by pressing one hand on the acromion, while the other hand was placed upon the inferior angle. This was a case of fracture of the scapula at the point of origin of the teres major. I treated it by means of the application of a large silk bag filled with cotton wool upon the fracture, and fixed on to the chest by means of an elastic roller. The arm was held to the trunk by a sling. This is the only case of simple fracture of the inferior angle of the scapula I have ever seen.

In all these forms of injury, the arm should be well supported at the shoulder by a well adjusted sling, and the shoulder and arm bound to the trunk by a roller, or by that complicated appendage of the arm to the trunk, called Desault's bandage.

## FRACTURES OF THE HUMERUS.

"Riding" of the bone.

There is no peculiarity in the fracture of the shaft of the humerus, requiring particular observation or treatment, beyond the application of general principles. The upper end generally "rides" forwards or upwards. This position is due to the action of the deltoid muscle, when the fracture occurs below the middle of the bone, and it must be met by a corresponding elevation of the lower portion or fragment. Three splints will suffice, if that which is placed behind is made to curve in the transverse direction, by being split longitudinally, and glued to thin leather. If four splints be used, care must be taken that they do not overlap. The upper arm, in very muscular subjects, is difficult to manage, on account of its rotundity rendering it unsuited to the application of splints. Full extension should be made before the splints are applied in the first instance. This should be effected in the semi-flexed position of the fore-arm, by which means we neutralize the actions both of the biceps and brachialis anticus muscles; and this position should be retained throughout the treatment, for by it we gain more in the approach to a suitable and soft substance for the reception of the anterior splint, by the relaxed condition of the biceps in front, than we lose by the slight degree of extension permanently made on the triceps behind.

Fracture of the neck.

Fractures of the neck and head of the humerus are often difficult of management. Fracture of the neck is occasionally complicated with laceration of the deltoid muscle, in the fibres of which the lower fragment becomes entangled, and from which it is exceedingly difficult to detach it. This fracture may be ascertained by placing the hand as nearly in contact with the head of the bone in the axilla as possible, and rotating the shaft. It is then obvious that the head does not move freely with it, and crepitus is very distinct. It may be distinguished from fracture of the glenoid cavity by the crepitus being larger and more distinct, and by its presence being felt in rotation during moderate extension of the arm from the shoulder-joint; whereas fracture of the glenoid cavity is only apparent in rotation of the arm, when the head of the humerus is pressed against its socket in the scapula. In fracture of the neck of the humerus, also, the head of the bone does not revolve with the shaft in forced rotation; and the attempt to rotate creates pain.

Rotation of arm.

After reduction of the bone by extension, a well-made pad of large size should be introduced into the axilla, against which the chief, and indeed the only practicable splint should rest; and it must be so firmly applied to the lower surface of the arm as to maintain permanent extension. The arm should be raised considerably from the side, and supported over a soft pillow, the patient himself being placed as nearly in a sitting posture as possible, in order to insure permanent extension, by the addition of the weight of the limb to that obtained by the splint already applied. When these and similar measures fail, the arm should be kept at rest over the pillow; and

Permanent extension.

we must trust to the curative powers of nature to restore it to utility, which she rarely fails in a great degree, to do. I have successfully treated several cases of fracture of the neck of the humerus occurring in young persons by the aid of the pillow alone. In the cases in which the bone is lodged within the fibres of the deltoid, the attempt to disengage it should be made by every reasonable means, such as rotation, pressure, elevation of the arm to its highest position, accompanied by renewed pressure on the projecting end of the bone. If these several means fail in accomplishing the desired object, the case must, with such slight assistance from art as we can afford, be left to nature for its restoration ; and we may rely on it, that our confidence will not be misplaced, if our expectation be not carried too high.

Fracture of the middle of the shaft of the humerus is detected usually without difficulty. If the fracture be transverse and above the insertion of the deltoid, the displacement is slight, and the treatment simple. If below the deltoid, we may have to contend against the action of that muscle in separating the upper end, by raising it towards and even into contact with the skin, and thereby, supposing the fracture to be oblique and the bone pointed, threatening to convert the simple into a compound fracture. In such form of fracture, either three or four splints may be employed with advantage, the longest of which should be applied behind on the triceps muscle. The breadth of the splints should be such as to preclude the probability of their overlapping. If the best management fail to retain the fractured ends of the bone in apposition consequent on the action of the deltoid, it is better to lay the patient in bed and extend the arm to an angle of about 40° with the trunk, with a view to paralyze its action. Some difficulty will be experienced in adjusting the splints if the arm be unusually muscular, and more especially if unusually short. Under these conditions if the fracture be oblique and the tendency to retraction great, the splints may be applied to the arm in a straight position and fixed to the fore-arm, even as low as the wrist. Under ordinary circumstances the arm may be bent at the elbow, and the fore-arm supported in a sling. More than usual care should be bestowed on the pads, which should be thick and protective without being bulky, and the pressure of the splints should be at least for a time more than ordinarily firm.

Fracture of the humerus above the condyles, is liable to be mistaken for dislocation of both bones of the forearm backwards. This remark has been made by Dupuytren, who considers this error in diagnosis a frequent one; indeed, he says, "there is nothing so common." I cannot admit the truth of the opinion, however exalted may have been the reputation of Baron Dupuytren in the French school of surgery; or perhaps I have been unfortunate in not having witnessed the examples given. I consider, from the tenor of the evidence, that the cases in question were really examples of dislocation of both bones backwards, but accompanied with fracture of one or other, or possibly of both condyles of the humerus. But it is inconceivable that any number of men, possessing even a moderate share of surgical knowledge, should habitually mistake a fracture for so comparatively simple an injury as a dislocation backwards. Still, fracture of the lower end of the humerus may be, though not commonly, mistaken for dislocation of both bones backwards, particularly when the swelling is considerable immediately after the accident. The evidence appealed to by Dupuytren, and derived from the gradual lapse of the bones when reduced to their abnormal relations, is by no means conclusive of fracture of the humerus, because the same displacement is most liable to occur in dislocation of the ulna backwards, when coupled with fracture of the coronoid process of that bone.

**Probable dislocation with fracture.**

These cases when reduced may be often treated by position alone, as adopted by Dupuytren. At all events it would be well to try the experiment; and for this purpose the patient should be placed high in bed, as nearly in the sitting posture as possible, and the arm raised at the side of the body, inclining over a soft pillow, into which it should be sunk, or a soft cushion may be fixed along the limb by means of tapes as described in fractures of the leg. Should this measure fail, by reason of the contraction of the muscles and the unsteadiness of the limb, the apparatus I have described in the introductory remarks on fracture, for making permanent extension, should be applied without splints, which then become unnecessary.

**Treatment by position.**

## FRACTURE OF THE FORE-ARM.

One or both bones may be broken. The evidence of fractured radius is often detected with difficulty, partly in consequence of its complete investment by muscle, partly because overlapping is prevented by the ulna, which retains its natural position, and partly on account of the great natural mobility of the bone, which renders it difficult to fix the upper end, while the lower is rotated. In all such cases of doubt, it is better to apply two lateral splints, as though the bone were broken, and to place the arm in the semiprone position, not only with a view to the comfort of the patient, but in order to prevent union of the two bones to each other. In the semi-prone position the bones of the fore-arm are most widely separated. Whenever it is necessary to apply splints to the fore-arm for fracture, their influence should extend to the extremity of the hand.

Apply splints to the extremity.

The bones of the fore-arm are liable to be broken immediately above the carpal joint. This fracture is usually made obliquely through the radius from behind, downwards and forwards. The ulna may, or may not, be involved. This form of fracture is supposed by Dupuytren to be frequently mistaken for dislocation of the hand and carpus backwards. I have elsewhere quoted his opinion, which declares the dislocation in question to be an accident unknown to his experience. He considers them to be fractures of the bones of the fore-arm, invariably. One important sign distinguishing fracture from dislocation, is its liability to displacement after reduction. I have seen examples of injury at the wrist joint, in which this evidence was conclusive in favour of dislocation, and I cannot but distrust the opinion expressed by Dupuytren in such strong and unequivocal terms. In dislocation of the carpus backwards, the anterior edge of the radius may be felt to occupy its normal position, and the styloid process of that bone retains its natural relation to the shaft. In fracture, the styloid process is not only displaced, by being driven upwards and backwards, but it lies obliquely with respect to the shaft of the bone. But all simple cases, whether of fracture or of dislocation, recover under judicious treatment. In either case the

Quære, dislocation or fracture.

Styloid process of radius displaced.

arm may be drawn into form, and the bones reduced, whether separation has taken place at the carpal articulation or through the body of the radius and ulna. If the extension required be considerable before reduction, it would form an additional argument in favour of dislocation. In both examples of injury, the styloid processes of both radius and ulna form our best guide. Two splints, well padded, should be applied, extending to a length sufficient to include the hand, which ought to be well supported in the semiprone position, and the hand forced a little backwards by a large and thick pad, corresponding with the palm. Great care should be taken to prevent the hand falling, and this object will be attained by enclosing the entire fore-arm and hand in a well applied sling.

## FRACTURE OF THE PELVIS.

Fracture in any direction.

Fractures of the pelvis may occur in almost any part. Perhaps the most common locality is that vertically, through the obturator foramen, including the transverse ramus of the pubes, and the vertical ramus of the ischium, or pubes. It may be fractured vertically, through the acetabulum, or more posteriorly, through the ilium, or separation may take place at the side of the symphysis pubis, or at the sacro iliac symphysis. This serious injury is always the result of great violence, such as a fall from a height. More or less displacement may take place, but the separation of the fractured bones is rarely great, consequent on the integrity of the opposite half of the pelvis. In many cases, therefore, the symptoms are very obscure, particularly if the broken bones remain in contact, and the attention of the surgeon is probably directed to some other ailment or injury, the patient may have sustained at the same time. The knowledge of the full effect of the violence sustained, may not be acquired till the following day. In the mean time the patient finds himself unable to move or to turn in bed, and is himself conscious of the presence of crepitus in every attempt to do so. In other examples the fracture is palpable from the commencement, but in such, the injured pelvis is the chief and primary object of interest to the surgeon. If

Painful spasm of the muscles.

separation has taken place, every movement of the body is painful, and spasm of the muscles is often very severe, probably caused by rupture of some fibres of the muscles attached to it. This is the case more especially in fracture through the ilium, involving the iliacus internus, and possibly the gluteus minimus, or what is not improbable, the edge of the bone may have punctured the muscles, and hence the spasm and the very severe pain that attends some examples of this injury.

In some examples the symphysis pubis is rent asunder, the force of the blow having detached the fibro cartilage from the bone on one or other side. In other examples, the rami of the ossa pubis are broken across.

The fracture may extend vertically through the ilium to the sacro-ischiatic foramen. This latter form of injury is the result of a heavy blow or fall on the side of the pelvis; whereas, fracture of the os pubis more commonly arises from a blow received from the front of the body. Fractures of this latter kind occur to the persons of grooms, ostlers, and breakers, by the rearing and the falling over of a vicious horse.

I have, at present, in St. Bartholomew's Hospital, a man, by occupation an ostler, who, while riding on horseback, was thrown backwards by the rearing upright of the animal, which fell heavily upon him. On examination immediately after the accident, I ascertained him to have large extravasation of blood over the region of the bladder, and also in the perineum, coupled with retention of urine. The left os innominatum was separated from the sacrum, and thrown backwards to the extent of one inch and a half. His left leg was totally paralyzed, both as regards motion and sensation. I could not detect fracture or displacement elsewhere, though it appears reasonable to infer its existence somewhere. I drew off his water, and, having placed the man under chloroform, I made extension of the leg, until I removed the projection of the os innominatum, and replaced it on the side of the sacrum. I bound his pelvis round very firmly with a round towel, passed tightly three or four times round his pelvis, and fixed below by two perineal straps. On the following day he had recovered the function of his bladder; and in three days sensation began to return to his limb. In a fortnight the leg had entirely regained its nervous power. In eight weeks, the man now walks with crutches about the ward.

The treatment consists in binding up the pelvis with a circular bandage. If the material be elastic, it will exert a more steady and uniform pressure, and the relief afforded by such means is immediate and great, all pain and spasm often subside directly on its application. I attended a lady with separation at the two symphyses of the pelvis, after labour. She was quite unable to move for months. I had a strong leather case made for her pelvis, the degree of pressure of which she could regulate at will, by the aid of which she perfectly recovered, and subsequently bore a child, without the least symptom of her former malady. Occasionally, even under good observation, a case of fractured pelvis may escape detection, to be discovered only after death.

Elastic pressure.

## FRACTURE OF THE THIGH BONE.

As in the case of the humerus, the chief interest of fracture of the thigh, relates to the extremities of the bone; viz., fracture of the neck, or of the shaft immediately below it, and that of the condyles, singly or both. Much has been both written and said on fracture of the neck of the thigh bone, but unhappily nothing very profitable for the subjects of this serious accident has emanated from the lengthened controversy that engaged the surgical world.* It is, however, notorious, that the neck of the thigh bone does not commonly unite after fracture, and especially so when the fracture occurs close to the head; and it is equally notorious that the neck of the thigh bone may, and often does, unite after fracture, under circumstances favourable for union. The old ground of want of vitality from physical conformation, to which the infrequency of union was referred, is now abandoned, and the fact is more reasonably attributed to the difficulty of keeping the broken bones in close apposition, and to the want of constitutional power in those more especially liable to the accident.

Occasional union of the neck of femur.

---

* I cannot refrain from bearing testimony to the admirable description which Professor Pirrie of Aberdeen gives of this accident and its consequences in his excellent work. Indeed, I do not know where the whole subject of fracture is more ably discussed.

The symptoms of *fracture of the neck of the thigh bone* are very conclusive, if ascertained by deliberate inquiry and examination. A surgeon whose opportunities of acquiring experience on such accidents are not very great, should refresh his mind by reference to written works, or to the authority of others, before determining the nature of the case, and the treatment he will adopt. To mistake a fracture for a dislocation is not a very uncommon error among those who witness these examples of injury but rarely, nor perhaps is it very surprising.

Symptoms.

These *symptoms* are,—first, shortening of the limb; secondly, eversion of the foot, with that of the rest of the limb, and loss of the projecting trochanter major; thirdly, rotation made without effort, especially inwards; fourthly, crepitus, distinct of its kind, when the limb is rotated *after extension*, the two broken surfaces being then brought into apposition; fifthly, the great frequency of the accident in old age; sixthly, the sense of severe injury sustained, and the greater severity of the symptoms of fracture, when compared with dislocation of the same bone; seventhly, in fracture, extension of the limb to the natural length is followed by renewed retraction. We often have ecchymosis also in fracture, though less commonly when the fracture is entirely within the fibrous capsule, which I have never seen in simple dislocation. The crepitus is unlike that caused by the friction of hard bones against each other. It is softer and more crackling, as though the two surfaces were not fully in contact, but caught against each other by loose fragments. In fracture there is often experienced considerable pain on pressure made on the groin.

Inversion of foot occasional.

Such are the symptoms generally attendant on all cases, but not invariably; and in some, indeed, we observe a remarkable deviation from them. For example, cases are recorded of inversion of the foot and leg, instead of eversion. Desault alluded to it. Mr. Guthrie * has described such an example, as also has Mr. Stanley; and Mr. Savory has met with a recent example; but they are exceedingly rare. A more striking exception to the above symptoms is occasionally found in their almost entire absence, of which I have myself seen three examples.

---

* Med. Chir. Trans., vol. xiii.

**Entire absence of symptoms.**

The first occurred in the person of an old lady of seventy years of age, who slipped in the act of moving from her bed to a couch. The fall could not have been more than nine inches. In this movement she broke her radius above the wrist. I examined, generally, all her limbs; but the fractured arm appeared to me sufficient to explain her discomfort, and she was not conscious of further injury. I remember well, however, to have observed that she raised her two lower limbs without pain or difficulty. I saw her for some days, and then discontinued my attendance. Two months afterwards I found her with marked symptoms of fracture of the neck of the thigh bone. She had shortening, to the extent of two inches, and complete eversion of the foot. On drawing the limb downwards, it immediately retracted to its former position. She had not moved from bed since I had last seen her. In a second case, which was brought into St. Bartholomew's Hospital, a man had partial eversion of the foot, with crepitus, sufficient to substantiate a fracture, and in the situation of the neck, as it appeared to me. In three weeks the retraction and eversion were complete, and the case no longer admitted of a doubt. The cause of this injury was a fall from the last step of a ladder on to the ground, and the man was middle-aged.

**Probable explanation.**

The solution of these rare cases appears to consist in the slight amount of violence by which the injury is sustained, and which, indeed, is not sufficient to cause separation of the ends of the broken bone. Slight motion at a future time may influence their relations, and the muscles then exert the power of gradual displacement, and hence shortening and almost necessary eversion.

A boy aged fifteen was brought into St. Bartholomew's Hospital, who had fallen out of a cart. He afterwards rode about the town for some distance, and limped home to his mother's house. For ten days he walked about lamely by the aid of a stick. He stated that in the act of turning round he was seized with pain in the hip, and fell to the ground, and was carried home. During the ensuing fortnight he moved about the house, and he was brought to the hospital with considerable retraction of the limb, and slight eversion. The obscurity of the case was very great, and much difference of opinion as to its nature prevailed. By the moderate application of the force of the pulleys, under chloroform, I detected crepitus, and the neck of the bone was clearly the seat of injury. A very carefully adjusted splint applied from the axilla above to the foot, which was fixed to a foot-board below, and by the aid of a well-made perineal belt, and the interposition of a screw let into the splint for the purpose of maintaining sufficient permanent extension, the bone united, and the boy completely recovered. It is not often that we have to contend against the permanent contraction of the muscles in a case of fracture of the neck of the thigh bone.

This projection of the upper end of the broken bone forwards is often an evil of magnitude, and claims from the surgeon his earliest and best attention. It is quite clear that the future union of the bone will be very imperfect, unless the two ends are retained in exact or nearly exact apposition; and this is impossible so long as the elevation of the upper end remains. This elevation is caused by the uncontrolled and often uncontrollable action of the psoas and iliacus muscles, which having lost their antagonism, viz., the weight of the leg, reverse their ordinary action, and draw the trochanter forwards. So long as this tendency exists, it will be very inefficiently met by pressure in any form, and the only alternative is found in position. The trunk should be raised almost to the sitting posture by which the reputed origins of the two muscles are made to approximate the trochanter; or the same object may be attained by raising the thigh by means of an inclined plane, to an altitude corresponding with the projection of the upper end of the bone.

Splitting of shaft.

In addition to the ordinary fracture of the neck of the bone, a further injury may be sustained by the upper end of the broken bone being driven into a split portion of the trochanter major and shaft, or generally of the shaft only. The part is generally so wedged in, as to preclude its extraction by any force that can be applied to it. The trochanter is partly forced asunder, but still continues prominent. There is no crepitus, and no retraction.—I know of no treatment that can be serviceable, beyond rest.

*Fractures below the trochanter* are less common than fractures of the neck of the bone. The mass of muscles that here surround the bone render the crepitus often indistinct, and the shortening may be absent altogether in transverse fracture. Generally the upper end projects forwards, by the action of the psoas and iliacus muscles, and more especially so in young children.

The mode by which permanent extension is made is by the employment of the long splint, on the principle of that recommended by the late Mr. Liston. The splint itself should exceed the length of the person from the axilla to the foot of the affected side by three or four inches. The pad, large and full, should extend beyond the upper end of the splint so as to curve over it in order to protect the muscles of the axilla. The splint is then fixed by broad rollers carried round the chest without involving the abdomen. A strap neatly made, and well padded with soft leather, is then passed along the perineum, bearing towards the affected side, and perforated by graduated holes, which are attached by a hook or screw fixed to the outside of the splint about three inches above the pelvis. Steady extension being then made on the leg, the bone is brought down and retained at its full length. The roller is now attached to the foot by sundry coils, and carried around the notched extremity of the splint, and upwards, so as to unite the leg to it along the greater part of its length. It is of little moment which end of the splint is first attached to the person. It is perhaps more usual to commence with the foot. Still, I am inclined to think, when we look at the bony fabric of the pelvis, which will bear pressure to a great extent, without injury to the functions either of the abdomen or pelvis, that a firm, and broad, and well-padded leather, or even metallic band, might be so applied around it, as to admit of the upper end of a long thigh splint being let into a socket formed on the affected side. This would leave both the chest and the abdomen disengaged, and answer every requisite purpose of permanent extension.

Double inclined bed.

The form of permanent extension proposed by the double-inclined bed, invented by the late Mr. Earle, is, for reasons I have already given, for the most part objectionable. I can readily believe that this useful agent, both of comfort and of cleanliness, might be profitably employed in the treatment of fractures of the neck, or of the shaft of the thigh bone; but the objection lies in the frequent disparity of length of the person and of the bed, and the extension generally fails. When of a length suitable to that of the body resting upon it, its application is excellent. For the application of an agent that will effect a continued extension on the thigh, in cases of oblique fracture of the shaft, with shortening, I prefer the apparatus I have described, to the long splint, as less inconvenient and more efficient.

So unsuccessful is the result of treatment of fractured neck of this bone in old persons, coupled with the evils of protracted confinement, that it is the practice of some surgeons to relinquish all direct attempt at union; and at the expiration of two or three weeks, to desire the patient, especially if much advanced in years, to move about—on crutches. Thus, bed-sores and other evils attendant on long confinement to the horizontal posture are avoided, and the patient recovers the moderate power of locomotion.

Side position for fractured thigh.

During the attendance of Mr. Abernethy on St. Bartholomew's Hospital, his custom was to place all patients with fractured thigh on the side, according to the practice of Mr. Pott, bending the thigh on the pelvis, and the leg on the thigh, and I cannot say that I find the practice of the present day more successful than his.

The femur may be fractured above the condyles, or across these large processes, into the knee-joint. The injury is detected without much difficulty. *In fracture across the shaft, immediately above the condyles,* the lower end may ride forwards, or fall below the level of the upper portion. In either case, it should be reduced, if possible, to its position, by judiciously made extension. Sir Astley Cooper recommended the knee to be bent, and placed over an inclined plane. But the desirableness of this position would something depend on whether the bones were thoroughly reduced to their respective surfaces or not. If the attempt to do so were successful, I can see no objection to the straight position; but, on the contrary, should deem it a desirable one, as more likely to ensure the entire apposition of the two portions of bone. When I say the straight position, it should be understood in reference to all affections of the knee-joint, that a position which is absolutely straight is by no means necessarily an easy one; but that, under all circumstances, the rest of the joint is consulted by the

Straight position.

addition of a small pillow placed in the ham, which will produce the slightest bend to the joint. To force the limb into a straight posture, without giving the requisite support to the back of the knee-joint, is to compel a position, that will, if not at first, shortly become irksome, and even painful.

In fracture into the joint, anchylosis not certain.

*Fractures through one or both condyles* almost necessarily extend into the joint. Under these circumstances, it is highly probable, though by no means essential, that anchylosis will follow. It is, however, far more likely that it will; and this likelihood is due to the violence done to the structure of the articulation, in addition to that sustained by the bone and soft parts around. With respect to the joint itself, the cartilage, with the synovial membrane, are almost certainly ruptured; spicula of bone may project into the cavity; the fissure may remain open, and the medullary fluid escape into the joint. All this leads to inflammation of no mild character or degree. The joint becomes distended; pain of many days' or of some weeks' duration follows, that no depletion will relieve; the cartilage is absorbed, and the joint destroyed. To meet this probable result, the limb should be placed in such a position as will ensure its future utility. Splints and severe restraint are useless. The joint should be laid over a pillow, well supported at the ham, and the knee be slightly bent.

## FRACTURES OF THE PATELLA.

Generally effected by muscular contraction.

Fractures of the patella owe their origin much more frequently to the action of the extensor muscles, which are inserted into them, than to external violence. This fact is established in general belief, however incredible it may appear; and it *is* almost incredible that any power of muscular contraction, however great, could be so applied upon a short thick bone, like the patella, as to tear it into two parts. It would be difficult, if not impossible, for such a separation to be effected by art. Yet the evidence that the bone is severed without even the proximity of external violence, is most conclusive, and that *consequent on the injury* the patient falls to the ground. The fracture may take place in any part of the transverse axis of the bone, either near the insertion of the muscle above, or near the attachment of the tendon below, or across the middle. As regards the question of entire recovery, much depends on the degree of retraction of the upper portion of the bone, which may be drawn upwards from the distance of half an inch, to that of four inches or more. I have seen the bone drawn by the rectus muscle considerably higher, than the attachment of the lower fibres of the vasti could be supposed to permit its retraction. No less remarkable is the fact of a second fracture of this bone, occasionally occurring at an interval of time, between the old line of union and the insertion of the muscles above. I have seen two well marked cases of this injury under the care of Mr. Stanley, in St. Bartholomew's Hospital. In one of these cases, the retraction, after the second accident, was considerable. Judging by the close approximation of the former line of junction, the first separation must have been much less considerable. The degree of elevation or retraction of the upper end is not the immediate result of the accident, but it continues increasing for some days after the injury, unless prevented by mechanical means.

A second fracture.

Treatment.

These cases are very difficult of management when the retraction is great. The portion of bone is so small, and the offending muscle so powerful, that we can, in reality, exercise little influence on the bone, our efforts being almost entirely limited to the endeavour to obtain relaxation of the rectus muscle. For this purpose, the thigh is raised considerably on the pelvis, and the leg placed in a straight line of extension on the thigh. By this means the rectus muscle is as much relaxed as possible; and it owes its relaxation not only to the straight position of the leg, but to the bent position of the thigh on the pelvis,—for the action of this muscle influences the position not only of the leg, but of the thigh. It is an error, not merely common, but almost universal, to attribute the flexion of the thigh on the pelvis to the psoas and iliacus muscles, which have really no influence whatever in raising the leg, as I have proved by experiment. This action of the limb is effected entirely by the rectus femoris, else whence the benefit of raising the thigh on the pelvis in fractured patella? If the rectus do not influence the position of the thigh, why not place the

Psoas, &c. do not move the thigh.

limb, in fractured patella, in the horizontal position, by which the extension of the knee can be as fully obtained, as in the elevated posture of the limb, usually adopted? It would appear that we had instinctively adopted the position most consistent with the entire relaxation of the rectus, although, according to general opinion on the action of this muscle, no advantage ought to be obtained by affecting the relations of the thigh on the pelvis.

Friction of the thigh.

It is very desirable to treat a case of fractured patella as early as possible after the accident, with a view to prevent a greater degree of retraction than has already taken place. As we can exercise no direct influence on the bone itself, all our care and attention is directed to conciliating the retracting muscles; and for this purpose the thigh should be gently rubbed from above downwards, beginning near the groin. I am inclined to think that the best position in which this operation can be performed on the patient, will be that of sitting upright in bed, or even that of bending forwards over the extended thigh and leg. In this attitude the skin is more relaxed than in the elevated position of the limb. The thigh should be rubbed and kneaded by the hand, and the muscle gently compressed from above downwards, till it shows a disposition to relax. Should this process, persevered in for an hour or more, fail to effect relaxation of the rectus, chloroform should be administered, and the process renewed under its influence. As the muscle relaxes, pressure upon it should be adopted by means of a roller applied around the limb, from the groin downwards, to about two thirds of the thigh. The objection to carrying the pressure too low on the joint, particularly if much effusion has taken place into the cavity, is obvious; but there is one especial reason against it, viz., that compression of the upper half of the bone, or even of the tendon inserted into it, would have a tendency to tilt up the broken surface, and present an edge, instead of a surface, to the lower half. Should these means fail to bring the two portions of bone into proximity, it is better to place the patient altogether in the sitting posture in bed, and to leave the thigh entirely open and free from restraint for two or three days, when, in all probability, the muscle will gradually relax to its fullest degree. The two fragments may then be brought into closer approxi-

Obliquity of upper end.

mation by means of a circular bandage into which are inserted two pieces of cork, fitted against each portion of the fractured bone, and drawn together by two elastic straps with buckles. As a general rule, union by ligament, as it is termed, is attended by difficulty in progression; but this rule is not universal. I have seen a case of fractured patella in which the permanent separation was, at least, one inch and a half, in which the walk was as perfect as in any other man.

I have no experience of an instrument invented by M. Malgaigne, which proposes to bring the separated portions of fractured patellæ into contact by the mechanical power of the screw applied through the medium of four pointed claws forced through the soft structures down upon the bone. The case requiring its application must be, to say the least, urgent in its nature.

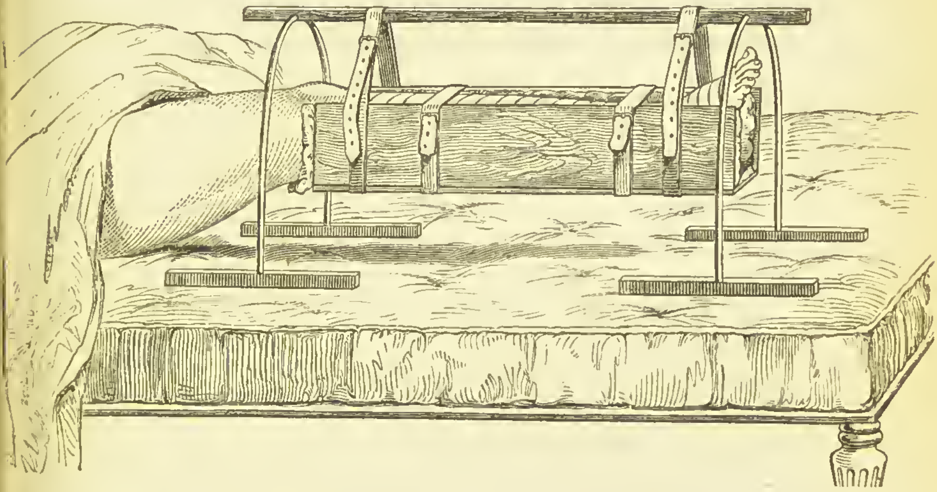
## FRACTURE OF THE LEG.

Position not important.

In simple fracture of either bone of the leg, singly, there can be but little displacement, and there is nothing to interfere with the onward progress of the case towards recovery. Supposing the bones to be well adjusted, it is of little importance in what position the limb be placed, whether on the back or on the side. Till within the last few years the side position was universal in London. This position is now almost as universally abandoned for that on the calf. When the leg is laid between two splints, on the side, the union of the fracture is somewhat more liable to be imperfect than in the straight position on the calf. This liability arises from the want of care in maintaining the suitable, indeed the necessary, attitude of the entire body, which should be inclined fully over towards the injured side. If the patient be permitted to lie on his back, the consequence will be, that the knee will rise off the bed, *and the toes will fall outwards.* Thus the union will tend to evert the foot, and produce an unsightly form, when he resumes the upright position. In order to take entire advantage of the side position, the two anterior spines of the ilia should be perpendicular to each other, and the toes should be raised. The leg inclosed in its splints should be bent nearly at a right angle with the thigh, and placed obliquely across the bed.

When the fibula alone is broken, it will rarely call for the application of splints. When severely broken, in dislocation of the foot outwards, splints are requisite, but it is of little importance whether the limb be placed on the back or on the side. A mode has been of late years adopted, of rendering the leg in fracture in some degree independent of the bed on which the patient lies, by swinging it in a cradle suspended by straps.

**Cradle.**



By the employment of the cradle some degree of general movement is permitted to the leg, without affecting the relations of the broken bone to each other. The position of the limb is remarkably easy and comfortable, judging from the report of patients who have employed it.

During the last two years I have treated with perfect success upwards of forty cases of simple fracture of the leg, whether of one or of both bones, by the application of a pillow laid on the bed, and simply fixed around the leg by means of three or four straps composed either of tape or leather.

There are some advantages attendant on this form of management worthy of mention. A pillow is very commonly at hand, when required for the purpose: I have never known a patient express any complaint of pain, and scarcely of discomfort from its application, so light and yet so universal is the pressure, or rather the support it affords to the fractured limb. But this degree of pressure, slight as it is, is sufficient to prevent retraction of the muscles even in oblique fracture of the tibia, for I have had no single case of shortening since I employed the pillow as a splint. I question whether the soft down pillow of a private house would afford so effective restraint as the coarser flock pillow of a hospital, which being firmer is more resisting in its material, but I have no doubt a well fitted ordinary pillow would answer the purpose. The bandages which retain the pillow in its position should be broad and strong, for some force is required sufficiently to compress the mass against the leg.

## ON RE-FRACTURE OF BONES.

Re-fracture of bone or the act of breaking down the recently united material, or callus, as it is termed, of fractured bone, has for its object the endeavour to obtain a more perfect union of the two ends of a broken bone imperfectly united, by reason of some error or imperfection in the management of the case. The evils resulting from such defect of junction are often great, whether on the ground of simple inconvenience, of local pain, or of absolute loss of power of the muscles attached to the affected bone. If a bone be fractured very obliquely across the shaft,—if the extending force employed by the surgeon have proved inadequate to the exact adaptation of the broken ends,—if the patient during the term of his treatment exhibit a restless disposition,—and still worse, if a discontented character of mind, which, as I have myself witnessed often impels him to watch the absence of the surgeon, for the purpose of regulating the pressure of the splints by the estimate of his own sensations of comfort : under these and similar circumstances, either the bones permanently overlap, or an angle is formed at the point of junction which is most unsightly. If the femur be the seat of this defect of union, whether it be the result of professional neglect or incompetency, or the officious interference of the subject of the fracture, his locomotive power is imperfect. If the length of the affected limb be abridged to the extent of one inch, the evil may be remedied by a boot, the heel of which should be raised to that of half an inch. By this addition, the uniformity of gait will be restored by the natural instincts of the muscular frame; but if the abridgment extend to the length of two and a half or three inches or more, the movements of the body in progression become seriously involved. The gait is unsightly, and a series of new actions of the body, hitherto unemployed in the act of walking, become indispensable to progression. If the upper or fore-arm be the seat of this imperfect union, the muscles may be so retracted as to derange the movements of the arm, and to render them both slow and difficult. To this condition scientific surgery offers relief in the form of re-fracture of the bone, for the purpose of retracing the treatment from its starting point, of re-modelling the limb, and of placing the ends of the bone in more perfect co-aptation. With regard to the period, beyond which the attempt cannot be made with any hope of advantage, it is difficult without frequent experiment to determine. I have broken the bones of the fore-arm without difficulty at the expiration of seventeen weeks, and the femur at that of eleven. I made a vigorous but unsuccessful attempt to re-fracture the femur after the union of ten months; but I have treated with success several fractures, within the former date.

Two important questions arise connected with the subject of re-fracture of bones, on which a few words of explanation appear necessary, and which were strongly urged against the proposal on the first occasion. The first relates to the point of fracture. I have often been asked how can you insure the re-fracture taking place at the seat of the original separation? What security have you that the bone may not break elsewhere? The answer is conclusive. We cannot break the bone except at the exact place of the original fracture. There are few men of sufficient muscular power to fracture a dried radius, even under the most favourable conditions. The dried bone is more frangible than the recent or living bone. When denuded of its soft parts, although held at a great advantage, it resists the most vigorous attempt to break it. How, then, is it possible to break the two bones of the fore-arm, surrounded by muscles which first bear the brunt of pressure, or *à fortiori* of the femur or tibia, to which the operation of re-fracture is more frequently applicable.

The second question refers to the possibility of non-union following the successful attempt to fracture the bone. If nature has firmly united the broken bone in the first instance, she will undoubtedly unite it in the second. The power of uniting broken bones is inherent in every sound constitution, and at every age. There is no term or limit to this process established by nature. The very fact of primary union infers the presence of ossific power. The secondary union is as perfect and somewhat more rapid than the first. Granted, therefore, first, the positive impracticability of fracturing a living bone of the smallest calibre for which the operation of re-fracture can be required; second, the all but certainty of re-union; third, the perfectly simple and innocuous nature of the operation itself as regards the soft structures; fourth, the imperfect or incompetent condition of the bone to be fractured: what argument of any force can be urged against an operation, which contemplates the removal of a serious evil to the frame without suffering or inconvenience of any kind, beyond the confinement inseparable from ordinary fracture? As regards the question of time, it is not a critical one. The only limit to time is the power to break. The attempt may be made at any reasonable date from the period of union. No evil of any kind follows beyond a slight sensation of a bruise on the dependent part of the limb. In the case above alluded to, in which after the most vigorous efforts I failed to break the bone at the expiration of ten months, the man walked back to his ward unconscious of injury of any kind, although on the day following he complained of pain, which continued for a day or two. It is certainly within range of possibility that the vessels or nerves of the limb may be rent asunder, but we dont deal in possibilities, but in liabilities only, and when we recollect the natural contour of the bone after union at the point of fracture, it must be acknowledged that such injury is beyond the pale of liability of the remotest kind. The vessels are commonly incased in fibrous tissue. The nerve will bear with impunity any moderate degree of pressure. The bone is free from projecting spicula. The vessels have sustained, without injury, a sudden and a greater shock on the former occasion. They are now to be subjected to a gradual and a lesser one.

The bone being broken by the simple process I shall presently describe, the long-continued contraction of the muscles, tendons, and the entire of the soft structure of the limb, has to be overcome by the agency of steady but powerful extension. Pulleys are requisite for this purpose, and efficient extension should be made to the end of restoring the limb to its original length, and continued during the application of such well selected splints or other agents as are calculated to resist a more than ordinary tendency to retraction of the muscles. The bone must be thoroughly broken, and the periosteal and other fibrous tissues immediately around completely separated, and for this purpose it is not sufficient that pressure be applied in one direction only. On the contrary, the limb must be raised and depressed, and carried round in all directions, in order to ensure the completeness of the separation. The sensation to the surgeon manipulating is not that allied to crepitus. The impression conveyed to the hand has nothing of the crispness caused by the contact of the fractured ends of a long bone, but more like the laceration of soft or fibro-cartilaginous substance, yielding under continuous pressure.

No preparations of the patient are required for the operation. Pulleys, splints, and all other requirements being at hand, the patient is placed on a table of any ordinary construction, or on a bed on which a board should be laid, the edge of which should correspond with the line of fracture. The board which should be thick and firm may be covered with eight or twelve folds of flannel or other soft material. A pillow is objectionable, unless of small size, as presenting an obtuse fulcrum instead of a definite one. The same conditions will of course obtain in the case of the arm, though their observance is somewhat more difficult. The patient may be seated in a chair, and the arm brought over the corner of the table. The object to be desired is the firm resistance of the fulcrum, without injury to the soft structures intervening between it and the bone. Supposing the femur to be the seat of the required fracture: after the full administration of the chloroform, the trunk and upper portion of the limb being well fixed by at least two assistants, the weight of the body of the surgeon is gradually thrown on the limb, employed as a lever of the first kind. Should the first effort fail, it may be repeated. Two persons of moderate strength may combine if requisite, and adapt their power most suitably to attain the end : usually the bone is separated by the first effort. Unless the adhesions be very strong, this force will suffice and the textures will be felt to break down. The separation should be rendered complete by carrying the limb in a circle around, the centre of which is at the fractured bone, and not at the joint above it. In case of re-fracture of the femur, I do not think entire reliance should be placed in the long splint applied alone. More immediate and local pressure is requisite, but the long splint is a valuable accessory in the treatment. An excellent paper on the subject of re-fracture by Mr. Wiblin of Southampton, is published in the *Medical Times and Gazette* of 1856.

# CHAPTER VII.

## OPERATIONS ON WOUNDED ARTERIES.

GREAT IMPORTANCE OF THE SUBJECT—HÆMORRHAGE—ITS TREATMENT—LIGATURE—WOUNDS OF ARTERIES—SYMPTOMS—TREATMENT.

Importance of the subject.

There is not in the whole range of operative surgery, any description of disease, the treatment of which by operative means, demands a more intimate knowledge of the anatomy of the human body than this. Here, the most difficult and the most responsible duties of the surgeon are occasionally called into instant requisition, without time for study or preparation of any kind. The importance of the arterial system in the economy, its liability both to injury and to disease, the depth and complicated relations of the individual vessels to other and contiguous structures, all attach to it the highest degree of interest to the operating surgeon.

Structure of arteries.

We are indebted to Haller for the first minute description of the structure of these vessels. From him we learn that an artery is composed of three coats, the external of which is cellular, filamentous, and elastic. To this coat the artery mainly owes its firmness, and its patency when cut asunder. The middle coat, which is fibrous, has been the subject of much investigation since the period of Haller. It is now deemed to be composed of muscular fibre, arranged circularly around the vessel, but intermixed with elastic tissue, the proportion of the muscular and the elastic tissue varying as the arteries reach the remote parts of the body, in which the latter is gradually reduced in quantity, and gives place to the contractile action of a muscular coat. The inner coat is a delicate serous membrane, continuous with the lining membrane of the heart. The two external of these coats are connected to each other by vessels which are distributed to the two outer coats only, and through which the coats themselves are supplied with blood. These minute vessels are called the vasa vasorum, and are derived from the external sheath of the vessel, and from the cellular tissue around. The supply of blood to the inner coat is doubtful.

When an artery is divided, blood pours from the wound with a force varying with certain conditions both of the artery itself, and of the wound made in its coats. This force is qualified, first, by the size of the bleeding vessel; secondly, by that of the artery from which it arises; and, thirdly, by the proximity of the wound in the branch to the main trunk. The tendency of an artery to pour out blood, depends also on the extent and form of the wound it has received. A longitudinal wound will bleed less freely than a transverse or oblique one. The evidence, however, on this subject is not conclusive or satisfactory. If the fibres of the middle coat of an artery are truly circular, the transverse wound should bleed less freely, the longitudinal more so.

Also, it is notorious that a marked difference prevails in the quantity of blood which escapes from an artery cut across, and an artery suddenly rent asunder, whether by laceration, or by a gun-shot wound. Under either of these latter circumstances, it would appear that the two internal coats contract instantly, and prevent the escape of any considerable quantity of blood.

Classification of arteries.

The division of the arterial system into branches of diminishing magnitude would not be altogether useless. In speaking of primary branches, we should include those of the largest size, such as the innominata, the carotids, the iliacs, the femoral and profunda, the subclavian and brachial; of secondary branches, the branches of the carotids, the vertebral, mammary, radial, and ulnar, the tibial and peroneal; of ternary branches, the thoracic, the branches of the brachial, the digital, and pedal vessels.

Ligatures; their use.

Ligatures are applied around arteries under three conditions: first, when an artery is exposed by the knife for the cure of aneurisms; secondly, when an artery is wounded in common with other soft parts around, as in punctured or lacerated wounds; thirdly, when it is entirely divided, as in amputation. In each of these forms of injury to the vessel, a different process is adopted. In the first we apply the ligature around a healthy artery in a sound condition, and uninterrupted in its course; in the second, having exposed a wound in the artery, we apply a ligature both above and below it; in the third, we tie up its open mouth.

Traumatic hæmorrhage.

The surgeon is frequently called upon to apply a ligature, in consequence of a wound in an artery causing *traumatic hæmorrhage.* In no form of accident or injury, are his knowledge, his manual dexterity, and his patience and self-possession more in request than on the occasion of hæmorrhage from a large and deep-seated artery. The evidence on which the necessity for this operation is founded, is generally unequivocal. If the limb be deeply punctured, and the accident be followed by the immediate escape of arterial blood, it is obvious that an artery is wounded, and provided the outer wound be moderately large, the blood will flow direct from the injured vessel, and escape through the external wound of the integuments. But if the orifice, both in the skin and in the artery, be small, the blood may escape from the artery and become infiltrated among the tissues around, which are gradually distended, in consequence of the pressure within arresting the flow of the blood, until the limb has greatly enlarged in circumference. Under these circumstances it may swell to an enormous bulk. The evidence to be examined now points to the following facts:—First, that the limb, prior to the accident, was free from disease; secondly, the occurrence of a puncture; and thirdly, the immediate though gradual swelling of the limb up to its present state of distension. This local condition can but be referred to internal hæmorrhage from some considerable vessel. The contents are soft and compressible, and must consist of fluid, not solid matter. What fluid? It cannot be serum nor pus, and the only alternative is blood. In occasional examples the large distension of the limb is only acquired after some hours, or even days, from the date of the accident, in consequence of the hæmorrhage ceasing and recurring at intervals, provoked, probably, by attempts at locomotion. But whether the distension of the limb be steadily progressive, or interrupted by intervals of cessation, the evidence is conclusive. The evil is often more or less aggravated by the painful degree of distension which the limb has acquired.

Important evidence is also derived from the state of the circulation below the wound. If the wound in the coats of the vessel be sufficiently large to admit of the escape of any large proportion of the current of blood circulating within it, the pulsation of the vessels below will be weakened in that proportion. If the main artery be totally divided, the pulsation will have entirely ceased, and loss of the temperature of the limb will necessarily follow.

Arrest of hæmorrhage.

In wounds of arteries, Nature adopts four different means for arrest of hæmorrhage.

First, the two inner coats of the artery retract within their sheath; secondly, these two coats contract towards the centre of the tube; thirdly, a coagulum forms within the outer coat, from the two retracted inner coats, up to the orifice in the artery; and, fourthly, syncope usually succeeds to a large and sudden escape of blood.

We are indebted to the discoveries of Dr. Jones * for our present knowledge of the three first of these agents, the results of much experimental inquiry, and we at once understand the admirable principle on which hæmorrhage is arrested by the hand of Nature, exhibited in the entire separation of an arterial tube, and the continued bleeding from a wound in a vessel which is partially divided, only because in the latter injury the coats can neither contract or retract. The same principle is illustrated in the separation of the umbilical cord in animals after parturition.

Surgical means for arresting hæmorrhage.

The resources of the surgeon are of course entirely extrinsic to the vessel, and embrace besides rest and cold the application of such agents as tend to the rapid coagulation of the blood, known under the terms, styptics, among which gallic and more especially tannic acid, matico, and perchloride of iron, are in occasional use; of the actual cautery, thus sealing up the bleeding

---

* The original preparations on which Dr. Jones founded his deductions on hæmorrhage have been presented by Dr. Farre to the Museum of St. Bartholomew's Hospital.

orifices; of pressure, by which the opposite walls of the vessels are brought mechanically into contact; closing the orifice of the artery either by laceration and forcible compression, as recommended by Mr. Webber, or by twisting its coats, a process known under the term "torsion," and, lastly, the application of a ligature. All these means are applicable, only to bleeding vessels exposed in wounds, stumps, &c., except the last, which is perhaps the only agent on which reliance may be placed in cases of severe hæmorrhage from wounded arteries. Occasionally, only, we resort to pressure.

Effect of a ligature on an artery.

When a ligature is applied tightly around an artery, the two internal coats are cut asunder, evidenced by a deep groove observed in the interior of the vessel. The sensation caused by the division either of a primary or a secondary branch is very perceptible to the hand of the operator. The necessity for this division of the two internal coats has been strongly insisted on by the British school of surgery, since the publication of Dr. Jones's work in 1805, and by many continental surgeons of reputation. The principle laid down by Dr. Jones, and deduced from his interesting experiments, is, that the union of the opposite sides of an artery is effected by the lymph thrown out from the coats so divided, both within the tube of the artery and between the coats themselves, and that this lymph becomes accessory to the consolidation, and to the final obliteration of the vessel. This doctrine is denied by Scarpa, its original opponent, who asserts that apposition alone will ensure perfect adhesion of the opposite surfaces; that the artery does not become obliterated by the organization of lymph, thrown out by the divided tissues along the circle of the ligature, and in its immediate neighbourhood, but by a process of adhesive inflammation, uniting the opposing surfaces of the serous coat.

Collateral circulation.

It is well known to all surgeons that when the channel through an artery is obstructed, the blood reaches the limb beyond the obstruction by means of collateral channels, formed partly by the increasing size of the original branches, and possibly by the formation of new arteries. This distribution of vessels which, if new, are formed with wonderful rapidity, co-operate with the normal inosculations of the part, to maintain the supply of arterial blood, requisite for its condition of health, and so perfectly and universally are these inosculations formed, that the hæmorrhage from a wound in a large vessel would prove quickly fatal, unless the wound be insulated by a double ligature. If a limb be injected with water, in which the main artery is cut across, and a ligature applied to the upper end, the fluid will escape with nearly the same rapidity as if the ligature were applied below the division. It was the knowledge of this fact that led Mr. Hunter to rely on the collateral circulation in his great experiment in the treatment of aneurism.

Space above ligature.

When a ligature is applied around a vessel such as the femoral artery, it has long been deemed important that space be left between it and the first considerable branch along which the inosculating communications will be immediately carried on, for the purpose of forming a coagulum; otherwise the blood will not coagulate in the vessel above the ligature, but pass along the inosculating branches in a fluid state, and the concussion of such blood, and the pulsations of the artery, may tend to break down, and eventually to destroy, the union of the opposite sides of the artery, causing secondary hæmorrhage, as it is improperly termed. The form of the clot above the ligature is dependent on the distance from it to the first considerable branch. It is always more or less conical, with its base towards the ligature, and the apex directed upwards; or, more correctly speaking, the clot is truncated and not conical. It is the supposed office of this clot to break the force of the current against the ligature, to protect it from the consequence of the continued impulse of the blood thrown into the vessel by the heart. It is, therefore, of importance to select that part of the artery for the purpose of exposure that is free from such objections. As a general rule, a full inch is, perhaps, the minimum distance at which it would be safe to apply a ligature around so large a vessel as the femoral. Where smaller arteries are concerned, the distance may be reduced.

Coagulum in artery.

Value of coagulum.

Later observations have tended to throw some doubt on the indispensability of the pressure of the coagulum in the artery above the ligature, in consequence of complete union having been occasionally perfected without it.

A case to this effect is detailed by Mr. Travers, in which a ligature was applied around the external iliac artery, between the origins of the epigastric and circumflexa ilii arteries; but in consequence of ulceration of the epigastric, the patient died of hæmorrhage. On examining the artery after death, no coagulum was found within it, although the union of the opposite sides of the artery at the ligature, was complete.

Wounds of large arteries.

Let us suppose a knife, or other cutting instrument, to have penetrated or transfixed a limb. If the bleeding be rapid and considerable, it is obvious that a large artery is wounded. Certain indications above described generally present themselves when the accident has involved a large vessel. The line of the wound points in the direction of the main artery of the limb; the flow of blood is very copious, resisting for a time the efforts of the bystanders to arrest it; the escape of the blood is attended by an audible rushing sound; syncope follows the first flow; the patient's face is pallid, and its expression betokens alarm. Such symptoms would usually attend hæmorrhage from the iliac or femoral arteries, and other large branches of the primary class.

If the wound has penetrated the limb very obliquely, or has transfixed it through, or nearly through the centre, in a transverse direction, we may have some difficulty in determining what vessel is the seat of the injury. Be it where it may, the safety of the patient, with rare exceptions, requires that we explore the wound, expose it to view, and pass a double ligature around the bleeding vessel. When such a case presents itself, the first measure to be resorted to is to put a tourniquet around the limb, above the wound, which, supposing the hæmorrhage to have ceased, may be applied with moderate tension, so long as the surgeon, or some competent representative, be near at hand.

Necessary examination of the wound.

The next duty of the surgeon, having placed his patient in safety, is to make all needful inquiries into the case, the nature of the accident, &c. He may learn, with advantage, the kind of instrument which caused it; he may cautiously pass into the wound a probe or a director, not, however, for the purpose of reaching the artery, which would be perfectly useless, but simply for that of ascertaining the direction of the wound. It is very desirable that he acquire accurate knowledge of the nature and extent of the hæmorrhage, on which subject great delusion prevails among the bystanders, who amplify to a most erroneous degree, and mislead the surgeon from the truth. One man is content with the assurance that the wounded person has lost a pint, or a pint and a half of blood, while the statement of another doubles the quantity, without hesitation. It would be desirable, if practicable, that the surgeon should himself bear witness to the amount of hæmorrhage that has occurred. The chief advantage of this information is, that it may enable him to form a tolerably correct opinion as to the size of the wounded vessel, and thus determine the operation he will perform.

Symptoms of wound in a large artery.

Suppose a man to have sustained a punctured wound on the inner part of the thigh; if the surgeon can ascertain that the rush of blood was vehement; that it was attended by a gushing sound; that the patient became rapidly pallid; that his clothes, and a large quantity of linen, became quickly saturated with blood; and, finally, if, on examination by the probe, the wound takes the direction of the trunk of the femoral artery, scarcely a doubt will exist in his mind that the main artery is wounded; while, supposing the direction of the instrument to have passed in a line somewhat posterior to the main trunk, a perforating artery may be the seat of the injury, and all the above symptoms may be greatly modified in degree, although the report of the witnesses will still declare the loss of blood to have been most alarming. To the timid and inexperienced practitioner such forms of hæmorrhage *are* alarming, for inexperience forms a natural and reasonable ground for alarm in such cases. If there be one trait above another that pre-eminently characterises the experienced and the competent surgeon, it is the perfect self-possession with which he undertakes and conducts to its close an operation of this kind. A thorough knowledge of the arterial system is indeed indispensable, and that alone can give us confidence in our own power to meet the endless variety in the catalogue of these injuries, as they occur in hospital or other practice.

Cases justifying the

When, from the above evidence, we have reason to believe that a large artery is wounded, it is usually our duty to tie it at once. There may be circumstances, however, under which we are, perhaps, justified in the resort to pressure as the means of obtaining obliteration of the artery in a punctured wound. If many hours have elapsed without a return of bleeding; if pressure could be efficiently applied on the vessel in the direction of the bone, as in the case of the femoral artery, punctured halfway down the thigh; or a very impaired state of the health of the subject, or a great liability to erysipelas,—such arguments might be urged as extenuating circumstances, justifying the resort to pressure under the protecting influence of a permanent tourniquet. But, under almost all circumstances, we should tie the artery.

resort to pressure.

When we have reason to feel confident in our knowledge of the nature of the injury, and in that of the artery wounded, we have the option either to follow the puncture, by dilating the wound in its course, or to reach the artery, by what I may term an anatomical and more direct path. In the first operation, the director, introduced throughout the entire depth of the wound, is our guide. It has the great objections of a wound made probably of considerable depth, through the substance of any muscle or muscles divided by the instrument; the counter-advantages consisting in the greater certainty of reaching the wounded vessel. It may happen that the artery which is wounded lies considerably nearer to the opposite side of the limb, and from which it is reached with facility. The direct route to the artery is that which of course would be usually selected, though it may labour under the disadvantage of uncertainty as to the vessel wounded; but it may yet prove the preferable operation, especially if, as in the case of a wound in the profunda or perforating arteries of the thigh, nearly the same operation will be applicable to the two vessels.

Operation to be selected.

I was called to the case of a butcher, who had sustained a punctured wound in the thigh, which, until a tourniquet was applied by a surgeon to the limb, had bled very freely. The nature of the accident was a singular one. The man was standing in his shop at some distance from the block, on which he had just deposited his knife. One of his men brought in a large mass of beef, which he

Case.

threw down on the block. The beef caught the knife by the handle, turned it over, and threw it, like a dart, against his master's thigh, at some distance off, which it penetrated to the depth of some three inches. The man was lying on the ground, in a back room, wrapped in his bloody linen; but the quantity of blood lost did not appear to exceed a pint, and some minutes must have elapsed before his neighbour reached him. The butcher's great anxiety appeared in the apprehension, which he repeatedly expressed, that he was damaged in the "Pope's eye." The dissection was an elaborate one; the femoral artery was untouched, but one of the perforating arteries was cut across.

Double ligature.

When the wounded artery is exposed to view, and the aperture in the vessel distinctly seen, two single ligatures should be placed around it, one of which should be tied above, and the other below the wound, each at a distance of a third of an inch from the puncture; the office of the lower ligature is to prevent the return of hæmorrhage by the collateral circulation. One end of each ligature may be removed, although both are occasionally retained by some surgeons, and the two remaining ends brought out through the outer wound, which should be healed by the first intention, if possible, in order to obviate the consequences of extensive suppurative action being established. The operation, for the same reason, should be done with as little violence as possible to the structures divided; for if the wound be unnecessarily large, and the surfaces jagged, it may prove a serious obstacle to such form of primary union of its opposite sides. If the operation be much protracted, and the injury to the surfaces consequent on the difficulty of finding the wounded vessel be great, it would be desirable, that *all the exposed portion* of the artery be insulated by the two ligatures,—placed as widely asunder as possible,—lest the vessel inflame in common with the parts around, and secondary hæmorrhage follow.

Branches of the artery to be included.

If an artery be wounded immediately above or below its junction with a large branch, the ligature most remote from the branch should be applied as usual, but danger may attend the process of reparation, consequent on the application of the other. If the branch in question be given off above the wound in the vessel, the lower ligature may be applied with safety around it; but the other ligature should include the trunk above the branch, supposing a less distance than nine or twelve lines existed between the wound and the branch, or rather between the ligature, if applied, and the branch. As a general rule, it would be safer to tie the artery altogether above the branch, if the latter be of considerable size, on the general principle previously discussed. If the branch be given off below the wound, within six, or even nine lines distance, it will be safer to employ three ligatures, one for the main trunk above the wound, one for the main trunk below the wound, and one, also, for the branch intermediate to the two. It is quite indispensable that the wounded portion of the artery be insulated from the circulation, such is the activity of the inosculating system of the body. There is no law in surgery more indisputable. Abundant examples of secondary hæmorrhage are on record, consequent on the application of a single ligature; and I know no better illustration of the fact, than that offered by the practice of a late eminent surgeon, who, in the case of a gun-shot wound in the groin, followed by continued hæmorrhage, tied the external iliac artery. The patient died from hæmorrhage from the circumflexa ilii, which was unrestrained by the ligature.

**Wound to be insulated.**

It is a considerable aggravation of injury if the vein be also wounded or transfixed by the instrument. This circumstance renders the result less promising, but cannot justify any departure from the principle of the operation. The wounded vein must be cut off from the circulation by means of one or two ligatures; I say one or two, because the valvular structure of these vessels, their profusion in number, and the comparatively torpid movement of the blood within them, may justify the application of a single ligature below the wound. Yet there would appear to be little reason in rejecting the second. An opinion is very prevalent in the profession, that a ligature applied around a vein is the cause of danger, by promoting inflammation along its coats. That such inflammation may be an occasional occurrence, is indubitable; but it is, certainly, by no means a frequent one. I believe the reports of danger consequent on the application of a ligature around a vein to be greatly exaggerated. In certain cases, however, we have no reasonable alternative

**Vein wounded.**

**Ligature on veins.**

but the ligature; and I know of no evidence which would justify us in rejecting it.*

Hæmorrhage from small vessels.

Small arteries, when wounded near their origin from a large trunk, will occasionally pour out a large quantity of blood, and very naturally afford ground for the opinion that a large vessel has been wounded. Considerable hæmorrhage may follow a puncture without either of the chief arteries being wounded. Of this I have seen many examples, which have occurred to patients brought into the hospital, when the surgeon has been compelled to rely on the statements of bystanders, who have reported, truly enough, that the bleeding has been great—great in their experience, though far less in that of the surgeon.

Case.

A butcher was brought into St. Bartholomew's Hospital, in the year 1838, who, in descending from a ladder, had transfixed his fore-arm, immediately below the elbow-joint, with his steel, which was hanging from a strap at his waist. The man was pallid from loss of blood, and a good deal alarmed. On examining his arm a wound appeared about two inches below the inner condyle of the humerus, through which the instrument had entered, and it had passed out at a second wound, just below, but somewhat in front of the outer condyle. The evidence seemed to point to the wound of a considerable artery, but whether brachial, radial, or ulnar, it was difficult to say, for either one or even both might have been involved, as blood had poured freely from each orifice. I proceeded (not without a consultation with my colleagues) to explore the wound, by exposing the anterior region of the elbow-joint. I brought into view the three arteries above alluded to, the median nerve, and the tendon of the biceps. I took a careful survey of the entire part of the wound which involved its relation with arteries, and I could find nothing. The man recovered, without further hæmorrhage.

A case of much interest was furnished me through an accident that occurred to a colleague some six years ago. While playing with a small penknife in the Museum at St. Bartholomew's Hospital, the knife slipped from his hand, and in the attempt to save it, he caught it open between his knees; and buried nearly the entire blade in his right thigh, about two-thirds of the way down, and nearly in the direction, so far as I could judge, of the femoral artery, in traversing what is termed Hunter's canal.

---

* I believe that this opinion, which I have long entertained, is now becoming more general among surgeons.

The arterial hæmorrhage was great, and reported still greater; the floor gave evidence to the fact that the quantity lost was not only great, but sudden. The thigh was bound up tightly, and he was conveyed to his house, and I saw him shortly afterwards. The limb had been rolled from the knee to the groin, and he was lying in bed—with a countenance somewhat paler than usual. Then arose the question, what was to be done. It was quite obvious that, supposing the femoral artery to be punctured, the cessation of hæmorrhage was temporary only, and that the artery must be tied. That there was no instant necessity for the operation was evident from the fact that the bandages were not discoloured—nor was there any increasing tension to indicate escape of blood within the limb. Having applied a tourniquet to the limb over the artery at the upper third, I removed the roller and examined the wound, both as regards direction and size, and also the penknife, as to its capabilities of inflicting a serious wound. I saw no reason to doubt the sufficiency of the length of the instrument to reach the femoral artery in the situation described, supposing it struck with great force, and I learnt that that condition was not wanting. I could not convince myself, however, that the direction of wound was exactly that calculated to reach the main artery of the limb. The line I conceived to be somewhat too posterior, either for the artery or the vein; and of the two vessels the vein was rather more exposed to injury than the artery, while the blood was clearly arterial, and not venous. The case, which demanded at my hands the appeal to the soundest principles of surgery, then presented itself to my view under the following circumstances:—The subject, himself an operating surgeon, and possessed of sufficient physical and moral courage to act for himself in any great emergency. The circulation in the limb under the check of a tourniquet, which either he, or a medical friend, who carefully watched him, both by day and night, might tighten in a few seconds should hæmorrhage recur. The limb was left uncovered. If I yielded to the repeatedly expressed opinions of other surgeons in favour of the operation, I should operate with the conviction on my own mind that the evidence was imperfect and inadequate to the demands of a large undertaking. Had the operative proceeding been less momentous, one difficulty had been removed. I examined again the quantity of blood lost, which, though large, I deemed to be less than the femoral artery would ordinarily yield in a young and active person. In the same scale I threw my own carefully obtained impressions of the direction of the wound. I called to my recollection other and similar cases, in which, although the hæmorrhage was great, no large artery was wounded; and, with this reasoning, I determined not to tie the artery without additional evidence of its necessity. That evidence has never yet presented itself, and after four weeks' confinement, my patient resumed his duties; nor has the opinion, that sooner or later he would become the subject of traumatic aneurism, been yet realised. I have stated the particulars of the above case, and the reasoning upon it, because it exemplifies an important principle in surgery, that the escape of even a large quantity of blood from a punctured wound, does not necessarily justify the resort to the knife.

**Exposure of bleeding surface to air efficient.**

In cases of hæmorrhage from small vessels, there is, in my experience, no agent at all comparable in its power to arrest bleeding, like rest and exposure to air. Whether it be the mere exposure to the atmosphere, or that the vessels contract more quickly when left unmolested, I do not know, but the fact is undoubted. The surgeon who has least fear of hæmorrhage loses the least blood. A small wound may be tortured by *styptics*, and by compression, and by other unprofitable agents, till it becomes the fruitful source of protracted hæmorrhage. Masses of lint are piled up in heaps upon the wound, pressure is maintained till all the parties concerned are exhausted, but still the hæmorrhage returns or continues, by reason of the irritation caused by the very agents employed, and nothing more. Under these circumstances, which I have repeatedly borne witness to, all dressings should be removed; the wound should be opened, and exposed to the air, by its edges being drawn widely asunder, and the bleeding apparently encouraged; its surface freely sponged with cold water, the coagula wiped away, and in this condition it may be fearlessly left to bleed. The cessation of the hæmorrhage by such means is often immediate. I was called up at an early hour, many years since, by a medical man, to consult with him on a case of hæmorrhage from a tonsil, which he had removed in the middle of the previous day from the fauces of a young lady. I advised him to take her to an open window, on the side of the house from which the wind blew, and to require her to keep her mouth wide open. On the following day, I learnt that the bleeding, by this simple expedient, had almost immediately ceased. A gentleman, in a state of intoxication, fell down and cut his head. The wound bled freely from the secondary branches of the temporal artery. This hæmorrhage continued from seven till twelve at night. When I saw him, his bed was surrounded by some six persons. The man had a pile of lint of about three inches in thickness on the wound, and another layer was about to be added to the mass. Contrary almost to the entreaty of the parties engaged, I removed the clotted and saturated lint, and freely sponged the wound, which I exposed to the air. The bleeding ceased within three minutes. On another occasion, I was sent for in the night to the Hospital, to assist in arresting the bleeding from a large wound below the axilla, that had been made on the previous day, by my late colleague, Mr. Earle. Three house-surgeons were present, and other persons. This man had lost a large quantity of blood by the same ingenious devices as those practised in the above cases. I proposed to remove the lint, and I was answered that its removal would be fatal, such was the tendency to bleed. I ordered the man's bed to be carried to an open window, and removed every appendage from the wound. The escape of some blood followed, and then entirely ceased. I have records of many other similar cases.

Cases.

Modern surgery recoils from the adoption of the practice of the past, in resorting to amputation in cases of hæmorrhage from a wounded artery. The amputation of a limb is perfectly unwarrantable, so long as the most strenuous and persistent efforts have not been made to discover the bleeding vessel. It is discreditable to resort to such an expedient, as a shield to our ignorance. If

Amputation.

we be unable to detect the lurking evil, it is our duty to apply for the co-operation of those in our own neighbourhood, who will at least share our responsibility, if they cannot remedy the evil. It is preferable to tie every recognised artery, before adopting the shocking alternative of removal of the limb. This resource is available at all times, and should only be resorted to when every other expedient has failed.

Half a century ago, the surgical profession were comparatively ignorant of the course of many of the ternary and quarternary vessels. The general principles of physiology had been maintained by anatomical discovery, but surgical anatomy was in its infancy. The removal of liability to hæmorrhage from an artery in the extremities by amputation was a not infrequent resort of the surgeon, consequent on the prevailing ignorance of the arterial system. In our days, such a resort would not be tolerated among competent men. The artery is to be sought for *and found;* and when each probable vessel has been tied, should the hæmorrhage still continue, it would be preferable still to wait and watch the effect of time, pressure, and cold. The latter, however, is but an inefficient agent, when employed to arrest local bleeding from an artery. Should bleeding still continue, the limb can but be amputated at last. Again, let me add, that if the arterial bleeding be considerable, it must come from a recognised vessel, which patient exploration rarely fails to discover: if it consist of oozing of blood merely, we should trust to time and position. Some modification of the strict laws appertaining to the treatment of hæmorrhage is required in wounds of arteries of the neck or trunk, as the following case illustrates, in which, if justifiable at all, the operation should be resorted to only as a last resource.

A wounded artery must be explored.

Case.

A case of interest came into St. Bartholomew's Hospital a few months since, which involved the principle of treatment of wounded arteries in a pre-eminent degree:—

A man, aged thirty, in the attempt to destroy himself, plunged the blade of a knife of four or five inches in length, into his neck, about two inches above the sternum. The instrument passed behind the sterno-mastoid muscle downwards towards the chest, to the extent of some three inches. The hæmorrhage was reported great. Bleeding recurred the following day to a great extent; the quantity being calculated at from two to three pints. The wound was examined by two of my colleagues, who failed to discover the source of the hæmorrhage. The orifice was small, but the cavity within large. The wounded artery may have been the vertebral, the inferior thyroid, the tranversalis colli, or the supra scapular. The wound was carefully plugged with cotton wool; five days afterwards the hæmorrhage recurred, and the man was supposed to have lost another pint of blood. The wound was re-examined, and again plugged with cotton wool, saturated with tincture of matico. On the following day a consultation was held, at which the surgical staff of the hospital was strengthened by the co-operation of Mr. Arnott, and many other surgeons. The decision arrived at, on a full consideration, was, that no present attempt should be made to arrest the hæmorrhage by operation. The grounds on which that decision was formed were the following:—1. No hæmorrhage had recurred since the resort to the matico solution. 2. The probable difficulty in finding the artery at the bottom of a deep but narrow wound, without careful and elaborate dissection under hæmorrhage. 3. The impossibility of resorting to the use of the tourniquet.

The true surgery of such a case I consider to be this: To prepare for the operation on the instant of return of bleeding; to watch the patient; and the instant it recurred, to make the attempt to discover the wounded vessel whatever the difficulty. To enlarge the outer wound, and proceed to lay bare, by careful dissection, all the surrounding textures. It is true that the undertaking is hazardous, and considering the quantity of blood already lost, the probability is, that the man would die on the table. However painful such an occurrence may be, it is the duty of the surgeon to save life; and this is the only proceeding which presents the chance of doing so.

The man died on the following day, after repeated small hæmorrhages. On examination, the inferior thyroid artery was found punctured about half an inch above its origin from the axis of that name. The vessel had been divided to about two-thirds of its calibre. The question of how far the injury having been perpetrated by the hand of a suicide, may be thrown into the scale of the extreme difficulty of the operation, coupled with the many chances of failure, may by many surgeons be deemed worthy of consideration.

# CHAPTER VIII.

## ANEURISM.

PATHOLOGY OF ANEURISM—VARIETIES—CLASSIFICATION—SYMPTOMS—PRINCIPLE OF TREATMENT—COMPRESSION—LIGATURE—OPERATION—TREATMENT BY MANIPULATION—TYING OF WOUNDED ARTERIES—OPERATIONS ON PARTICULAR ARTERIES.

Pathology.

The arterial tubes are subject, among other diseases, to a morbid change in the structure of their coats by which they are no longer able to resist the action of the heart, and dilatation of the walls is the result. This disease is aneurism, and is derived from the Greek word to dilate. The first deviation from health consists in a deposit of soft matter, commonly called atheromatous, in the substance of the middle, or fibro-muscular coat, or between it and the inner or serous coat of the artery. Gradually the two internal coats become disorganised and destroyed, and the artery, now reduced in strength by the partial destruction of its walls, gradually yields to the force of pressure from behind, which dilates the external coat into the form of a sac or pouch, into which the blood escaping from the direct arterial current, is deposited, and there coagulates. This is the most common form of arterial disease. In other examples, however, in consequence of some obscure change in the condition of the internal coats, less apparent to the eye, the sac is formed by the dilatation of all the three coats of the vessel: a pathological fact established by Mr. Hodgson. Whichever of these two varieties may prevail, the tendency of the disease, when once established, s to increase, until the walls of the sac become so attenuated as to be incapable of supporting the force of the heart's action. The tumor then bursts, and a fatal hæmorrhage terminates more or less suddenly the patient's ife.

Such is the origin and progress of ordinary aneurismal disease, to its ultimate crisis. We find it, however, subject

Varieties. to great varieties in its nature and form of development, expressed under the terms, true and false aneurism, circumscribed and diffused. Much confusion prevails with regard to the definition of these and other terms employed to distinguish the varieties of aneurismal disease. The words true and false are especially unfortunate in this respect. Many authors define a true aneurism as that variety in which the sac is formed by a dilatation of all the coats of an artery, while others restrict the term false to those aneurisms in which the sac is deficient in all the arterial coats. To the surgeon, in his pathological character, it may be interesting to determine the exact nature and proximate cause of the tumor, but as connected with practical surgery, there is no feature of the disease which he is less desirous of the opportunity to become improved upon, and none which had he the power to acquire a perfect knowledge of would prove of less value to his patient. All aneurisms requiring for their cure some check to the current of blood in the vessel supplying them are, in one sense or other, circumscribed. If they are not so, the operation usually adopted would be a most inefficacious one. It is because they are circumscribed that it has been so commonly successful.

I have adopted the following classification : Aneurisms are either, TRUE, FALSE, or MIXED.

ANEURISM.

### TRUE.

The sac is formed either—(1), by a dilatation of all the arterial coats, or (2), by the external fibro-cellular coat alone, the two inner coats having given way.

Sacciform.
Fusiform.
Cylindroid.
Varicose.

Terms applied by Breschet to the shape of these aneurismal tumors.

The term "*aneurismal dilatation*" is applied to that variety in which the whole circumference of an artery is dilated.

*Dissecting aneurism* is a very rare variety. The inner or inner and middle coats of an artery having given way, the blood is forced between the coats into the connecting cellular tissue.

*Hernial aneurism* is extremely rare, the two outer coats being perforated, the inner coat is protruded through the opening.

### FALSE.

None of the arterial coats enter into the formation of the aneurismal sac.

#### *Circumscribed.*

A complete sac is formed of condensed cellular tissue.

#### *Diffused.*

Sometimes called *primitive false aneurism.* No distinct sac is formed, the blood is effused into the surrounding cellular tissue through a wound or ulcer in the coats of an artery. If through a wound the term *traumatic aneurism* may be applied.

### MIXED.

The sac of a true aneurism has given way, and the blood has escaped into the surrounding cellular tissue. (Dr. A. Monro, sen.) To the false aneurism thus formed, the term *consecutive* is sometimes applied, to distinguish it from primitive false aneurism.

Coagulation in sac.

In consequence of the current of that portion of the blood which escapes from the artery into the sac being arrested, by losing the force of the heart's action, it coagulates, as is well known, in concentric layers. The contents of the sac may be composed of solid and fluid blood, in any proportions, the fluid part occupying the centre, the solid the circumference. We occasionally find the aneurismal tumor solid and firm throughout its entire substance. At other times it is equally soft, indicating that its contents are chiefly fluid. It is a part of the inquiry of the surgeon to examine the sac carefully, and to ascertain the nature as well as the quantity of its contents. If firm and incompressible, and if painful on pressure, the contents will consist of coagulum. If soft and dilated in size, the proportion of coagulum will be small. If the surgeon now apply one hand on the artery, above the disease, and press with sufficient force to arrest the circulation, and place the other on the tumor, on which he should exercise gentle pressure, he will empty the sac of its fluid contents. Thus he will be able to judge, by the quantity of solid coagulum left behind, about what is the proportion of each. The excess of one, over the other state of the blood, depends greatly on the form and size of the opening in the artery leading into the sac. If the opening be large, the contents will be mostly fluid, and this is readily tested by observing the length of time required to fill the sac. If the pressure on the artery above be suddenly remitted, after having been continued sufficiently long to empty the sac of its fluid contents, while the other hand is placed on the tumor, we shall be enabled to ascertain with some precision how many pulsations of the artery are required to fill the sac, and the rapidity with which the cavity is re-distended would lead to the opinion that nearly all the blood takes this direction. I have observed the short period of six or seven seconds sufficient to distend a large aneurismal tumor in the ham. The nature of the contents of the sac may also be inferred, with some approach to truth, by the character of the pulsations, which are more distinct, both to the sense of sight and of touch, when the contents are solid.

Case.

In the year 1842, a man was brought into St. Bartholomew's Hospital, with a large tumor in the right ham. Opinions were very much divided as to its nature. Some deemed it aneurismal; the majority, not. The tumor entirely obliterated the popliteal cavity, and extended upwards between the flexor muscles of the thigh, half way between the knee and hip-joints. The pulsations were scarcely perceptible. I examined the case very carefully, and fully convinced my own mind, that it was a case of popliteal aneurism, of a nature which I can only express by saying, it was exceedingly diffused for a circumscribed aneurism. That the blood had escaped from even the dilated coats of the vessel I felt confident, from the fact, that the tumor extended many inches higher than the point of entrance of the artery into the popliteal space. On the following day I examined this case, in company with my late friend Mr. Langstaff. After a full inquiry, he said he considered it a malignant disease, and was leaving the ward, when I requested him to renew his examination. I then introdused my hand under the bedclothes, and placed my thumb on the iliac artery, begging him once more to place his hand on the tumor. I then compressed the vessel unnoticed by him, when he exclaimed, with infinite surprise, "Why, the tumor is going away! It's gone away!" Remitting the pressure, the tumor again filled with rapidity, when his expressions of astonishment were still greater. I then explained the mystery, and he left the ward with the fullest conviction that the malignant disease was a case of aneurism. And so it proved. The man was operated on and recovered. On another occasion I applied the same test to a case of doubted aneurism of the brachial artery, in the presence of several medical men, most of whom were previously sceptical as to its nature.

Symptoms.

Let us now examine into the nature of the evidence which points to the existence of a true aneurism. On this evidence we enter carefully and deliberately, leaving no link in the chain unexplored; for although we may truly determine its presence in favourable localities, and coupled with palpable indications, yet in others we are apt to mistake similitudes for realities, and to jump at conclusions, rather than achieve them by careful induction.

Pulsation of real aneurism.

The most striking feature is, 1st, a pulsation of the tumor synchronous with the beat of the artery; not the effect of a mere movement of the tumor in unison with its pulsations, but a *general swelling*, caused by *universal expansion* of the cyst; and which is more or less distinct, as the contents of the sac are more or less fluid. The *movement* of the tumor is greater in a case in which the contents are solid;—the *expansion*, when fluid.

Position.

2ndly, the tumor should occupy the line of a well-known artery, and generally some well-known region, such as the groin, the ham, the neck, or the supra or sub-clavicular region.

Effects of pressure on arteries above.

3rdly, if the artery be compressed above it, the tumor, will decrease in size, and swell out to its former magnitude, on remitting the pressure. If the tumor be not aneurismal, its magnitude will continue unaltered. Of all the signs of aneurism this is the most uniformly unfailing.

"Bruit."

4thly, on applying a stethoscope, or the ear, to the tumor, a rushing sound is heard; to which, such is the poverty of our language, the term "bruit" is still applied by English physicians. This sound, however, is not confined to aneurismal disease.

Reduction of pulse beyond.

5thly, the arterial system beyond the tumor is generally affected; that is to say, the vessels are reduced in size, from the encroachments of the tumor on the main vessel, and by the interruption of the direct line of the current, consequent on a certain quantity of the blood passing into the sac.

Swelling of the limb.

6thly, the proximity of the diseased artery to its corresponding vein may cause more or less obstruction to the venous blood, and the consequence will be, swelling of the limb below the tumor. Too much importance, however, should not be attached to this feature, which other diseases have often in common with aneurism.

Pain beyond.

7thly, pain below the tumor is a frequent concomitant of aneurism. Aneurism in the popliteal region is often attended with pain in the calf of the leg.

The combination of the above signs is more than sufficient to warrant the diagnosis of aneurism; and they are very commonly obtainable, by careful inquiry and observation, in their aggregate number. All, however, are not essential to an affirmative decision; for example, if Nos. 2, 4, 5, 6, and 7, were found in combination, a tumor lying in contact with the arterial trunk might represent an aneurism and mislead an inexperienced inquirer. The tumor might occupy the line of a well-known artery, and receive pulsations in unison with it.

A rushing sound is not confined to a diseased condition of an arterial tube, the tumour may be so placed as to press on the calibre of the artery contiguous to it, and to interrupt its current of blood; the vein may also be compressed on the same terms, and pain below is common to many growths; but if to the above we add the conditions given under the heads of Nos. 1 and 3, if we detect, not merely unison of pulsation with the artery, but general increase, and universal expansion of the tumor, swelling out on all sides, and its positive decrease of size if the artery be compressed above it, and renewed expansion when the pressure is remitted, then we have the unequivocal signs of true aneurismal disease.

Among the more common examples of false diagnosis may be enumerated :—The liability to error in cases of enlarged glands, or other tumours of the neck. The difficulty in the decision is founded on the limited space, and the compact structure of the region, and the deep relations of the growth under consideration. The pressure required to reduce the magnitude of the sac is painful, and it is often impossible to obtain evidence from pressure on the carotid artery below the swelling. We may have a pulsation synchronous with that of the artery—a rushing sound—pressure on the jugular vein—and pain sufficient for any form of disease; but it will not prove to be a case of aneurism. All these symptoms may prevail whether the growth be that of an absorbent gland, or a portion of the thyroid body of the two diseases; the latter is perhaps the more obnoxious to suspicion, and more frequently misleads the young surgeon to a false diagnosis, and especially so when, as in some examples, it has acquired a jerk from the pulsation from its own arterial system.

In the course of the year 1848, I had three such supposed cases of aneurism under my care. The last of these cases gives remarkable evidence of the necessity of careful inquiry.

I received a letter from a surgeon in the country not deficient in power of observation, stating, that he had been summoned to a distance from home to see a patient with supposed aneurism of the carotid artery. He added, that he had a clear recollection of all I had formerly said to him and others on the subject of diagnosis of aneurism, and that he thought he could not be mistaken; that if it proved, contrary to his anticipation, to be a case of carotid aneurism, he should send the patient immediately to the hospital. In a day or two the man arrived, and exhibited a large fibrous tumour of the neck raised by contact with the artery beneath it. Tumours in and above the axilla raising the clavicle, may also lead to the supposed presence of aneurism of the axillary trunk. Enlarged inguinal glands, or other forms of disease, extending upwards into the iliac fossa; general inflammation of the absorbents of the ham; great enlargement of the bursa, under the semimembranosus muscle, may be mistaken for disease of the iliac, femoral, and popliteal arteries. One of the most fruitful sources of error applies to tumours of a malignant character, involving the structure of bone, and are most commonly found occupying the bony pelvis. The inaccessibility of the disease to the requisite manipulation, the well-defined pulsation, and the gradual increase, all combine to render the diagnosis most difficult; and probably there are few surgeons whose first impressions would not favour the existence of aneurism in preference to the actual disease. Finally, we should keep ever in our recollection, and attach a just value to evidence of a negative kind. Aneurismal disease is rare. Its imitations common. The real disease is readily detected by observing men. The very fact of an elaborate investigation, and of much weighing of evidence in favour of the one or the other disease, is almost fatal to the supposition of true aneurism. We may mistake the factitious for the real in aneurism, as in many other diseases; but we rarely mistake the real for the factitious.

Spontaneous cure.

Large aneurisms occasionally undergo a spontaneous cure; and, although such a result is a very rare event, in relation to the aggregate cases of this disease, yet the occurrence is sufficiently well known as incidental to aneurismal diseases, to become an important matter for consideration in some of the most formidable examples in which the operation is generally fatal. This end is effected most frequently by the sloughing of the tumour, which process may possibly be the result of increasing pressure on parts not very fully organized. The whole tumour undergoes a change of colour, loses its vitality, and

Sloughing.

eventually separates. Most frequently, however, this process is attended with fatal hæmorrhage.

Suppuration.

Sometimes the sac is attacked by suppurative inflammation, and the entire mass is converted into a large abscess; and, thirdly, the contents of the sac, already partly solid, may become entirely consolidated, the entrance of any additional quantity of blood being precluded by the blocking up of the orifice, and the tumour becomes gradually absorbed. These exceptions to the general rule, with regard to aneurismal tumours, are so far rare, as to offer no serious obstacle to the treatment by operation, when the disease attacks a vessel among the small class of the secondary, or any other ternary divisions; but, in calculating the chances of success attending an operation for tying the subclavian or iliac vessels, this question should not be omitted.

The nature of the disease being determined, the surgeon is now to select the best means of obliterating the vessel leading to it. The opinion formerly prevailed among pathologists of the necessity of postponing the operation until the collateral circulation was fully established; but an improved physiology has shown such postponement to be unnecessary and hazardous, such is the activity of the vessels, and such are the necessities of the part below the disease.

The principle of treatment adopted for the cure of aneurism, consists in cutting off either partially or entirely the supply of blood to the sac of the diseased vessel. If the force of the circulation through the artery be brought within the influence of the *vis medicatrix*, the blood will coagulate in the sac; the sac itself, now protected from the influence of the heart's action, will contract, and the disease ceases to exist. The modes in which this end is obtained by surgical agency are chiefly twofold. First, by the mechanical obstruction to the current of blood in the artery by means of external pressure; and secondly, by cutting off the current by the application of a ligature around the vessel on which it is formed. It is well known to all persons engaged either in the study or the practice of surgery that from the period of Mr. Hunter, to within about fifteen years from the present date, the latter has been the established practice of the profession; and contrasted with the ancient method of dealing with aneurism, viz., that of opening the sac, evacuating its contents, and tying both ends of the diseased vessel, it has proved eminently successful. But this success has been but comparative, having in the aggregate of cases, treated by the profession at large, a mortality of from 20 to 25 per cent.

Dr. Norris has published, in the *American Journal of Medical Science*, the results of 177 cases of aneurism treated by the ligature. Of these, 38 died from the operation, or more than one-fifth, and of the remainder 6 underwent amputation. Dr. Crisp in his treatise on diseases of the blood vessels, in 188 cases records 103 cured, 35 deaths; and out of the cured, 11 underwent amputation. Mr. Phillips, quoted by Mr. Storks, collected 171 cases, of which 57 died, or one-third, and 15 of the successful cases had secondary hæmorrhage.

Had the frequency of these results of an operation, to which the large proposition of failures necessarily attached the stamp of danger, been capable of reduction by our closer observation of their cause, the profession would probably have remained content with the treatment hitherto adopted, but it would appear that the frequency of a fatal result was a condition inherent in its nature, and that if so large a proportion of cases either proved fatal to life, or demanded the resort to amputation of a limb for the purpose of preserving life, it is not an unfair inference that danger in some form or other hovered over all. I do not wish to represent the treatment of all aneurisms by the ligature as dangerous. The term danger applies only to the larger forms of the disease, and a proportion of failures to recoveries in a ratio of 25 to 75 may well justify its application. Among the usual causes of failure were gangrene of the limb, abscess with or without secondary hæmorrhage, sloughing of the sac, &c. These are not issues like pain or inflammation, to be averted by treatment, however skilful; they only prove the inefficiency of our curative means. They are not commonly referable to the imperfections either of the art or the operator, but rather to a constitutional condition of the individual patient and common to many.

Between two acknowledged modes of treatment equally efficient in their results it is the first duty of the surgeon to select that which accomplishes its end with less danger to the life of his patient. This I hold to be a sound moral principle, which should actuate every professor of the healing art. Its merit is readily brought to the proof. Mr. A., the "eminent surgeon" is himself the subject of popliteal aneurism. Who will he select as his adviser and attendant ? Doubtless, the man of ample experience, whose boast it may be, not that he performed such and such an operation, but that he restored his friend to health. An honourable mind would repudiate the merit of success obtained through the medium of unnecessary danger to his patient. The mortality of treatment by ligature equals at least 25 in every 100 cases of large aneurism, under which title I include the varieties of femoral, popliteal, carotid, and axillary. The question then naturally arises what is the amount of success, and what the rate of mortality derived from treatment by compression.

## TREATMENT BY COMPRESSION.

Treatment of aneurism by *Compression* has been the uniform and established practice of the surgeons of Dublin, and of the Irish provinces during the last sixteen years. Upwards of 60 cases, almost consecutive, attest the soundness of the principle. It is proved beyond all question that if the current of blood traversing the femoral artery leading to a popliteal aneurism, be reduced by such amount of external pressure as shall approximate the opposite sides of the vessel without entirely closing it, that the retarded, or rather the diminished current of blood flowing into the sac, will coagulate, and obliterate the cavity by insulating it from the circulation. If the opposite walls of the arterial trunk be brought into complete contact, in other words, if the flow of blood be entirely arrested, then the material required for coagulation fails, and the disease continues for a longer or shorter period. The principle demands a limited current through the artery leading to the sac. The name of John Hunter is identified with the treatment of aneurism by the application of a ligature at a distance from the sac, to which probably thousands of persons have been indebted for prolonged life, but the mortality of 25 per cent. still weighed heavily in the scale against the Hunterian operation, and the names of Todd, of Hutton, of Bellingham, of Cusack, of Tuffnell, of Crampton, and of Porter, will be equally identified with the discovery and the adoption of a principle yet more sound and more successful than that which gave to British surgery the reputation of acknowledged leadership throughout the continent of Europe in the cure of diseases of the arterial system.

If therefore we test the value of a principle by the service it renders to humanity, if the preservation of 25 per cent. of human lives, among those who are the subjects of aneurism, can be termed a good service rendered equally to the cause of humanity, as of pathological science; the discovery of this novel method of obliterating an aneurismal sac, is a great fact, and a crisis in the history of scientific medicine, and its discoverers merit something more than a passing tribute of professional approbation. It may be undisputed that Mr. A. or Mr. B. has successfully tied the femoral artery in fifteen or even twenty-five consecutive operations. It is equally true that the same operation, undertaken by hands equally skilful and equally experienced, has proved eminently unsuccessful. To what assignable cause this remarkable difference? Is it to the modus operandi, to the difference of after treatment, or to the greater skill in the selection of the subjects for operation. There is no evidence to prove the pertinence of either of these three causes of results so opposite. My late friend Mr. Vincent made it a modest boast that he had performed a certain large operation in surgery twenty-five consecutive times without a fatal issue. The three next patients placed under his charge all died, although all the apparent conditions were coincident in the entire list.

The treatment of aneurism by compression, originated, adopted, and advocated by the professional authorities of Dublin, has been received with some expressions of doubt and mistrust on this side of the channel. The expressed mistrust, however, never exceeded a kind of under-growl of disapproval at the prospective exclusion of an old and cherished favourite closely identified with the name of Hunter. Its adoption by the leading surgeons of England and Scotland, with rare exceptions, required but the agency of time for reflection, and the natural and commendable ambition for distinction which is inherent in our nature. It has been objected that the cures were not radical in their nature, that the pain of pressure was insupportable, that the consequences of pressure on the artery rendered the future resort to the operation by ligature more than usually hazardous. To these objections there is no solid foundation, and they scarcely merit the effort at refutation, because if the sac be obliterated it signifies not what the agency, one method of cure being in an exact degree as radical as another, and that the pain of pressure is not insupportable, may be reasonably inferred from the fact that a long list of some sixty or seventy cures have been effected under it, while the latter objection is supposititious and not real. Treatment by compression may be deemed an established principle in surgery, and for the adoption of which, the old operation is laid aside for exceptional cases, to be resorted to only when the conditions demanded in the treatment are incompatible with it. These conditions are, the feasibility of applying a tourniquet, if possible, over two parts of the artery on which the disease is placed, and that the patient be competent to sustain the force of the required pressure until the blood coagulates in the sac. It cannot be denied that the treatment is irksome to both body and mind; the constant sense of pressure causes expressions of discontent. While, mentally, the suffering that precedes the crisis of an operation is always borne with less fortitude than that which succeeds it. All other requirements as to health, &c., equally apply to the two forms of treatment, and need no especial reference.

The consideration due to the question of time is not to be unhesitatingly granted to treatment by operation, because the crisis of cure brought about by the consolidation of blood in the sac may occur in as short a period as the recovery from the operation would usually require, and occasionally in less.

**Practice of compression.**

Let us suppose a case of popliteal aneurism to be under treatment. A quick circulation is to be brought under check, the force of the heart's action moderated both as to power and frequency of pulsation. Food restricted in quantity, one or more doses of purgative medicine administered, and if necessary, blood taken from the arm. The latter proposition is applicable only to plethoric persons. The upper and inner surface of the thigh to be shaved and dusted with French chalk or flour. The bed and all other appliances to be carefully selected. One tourniquet is applied immediately below Poupart's ligament; a second about five or six inches lower down the limb, in fact anywhere where it will act efficiently, but pressing the artery in the direction of the bone. These two instruments are applied alternately, the period of change being determined by the tolerance of pressure. The degree of pressure to be such as will *considerably* reduce the pulsations of the sac, but not to destroy them: the pulsations being perceptible to the ear, but neither perceptible to the eye nor to the hand. The two latter senses appeal to the surface of the tumour, the first to the centre: The object to be kept in view by the surgeon is to restrain the current through the supplying vessel to just such a degree as will allow blood to pass in small quantity only into the sac where it coagulates in layers, separates from its red particles, and becomes adherent in fibrinous layers to its inner surface. Then the sac is thickened, and being thickened is strengthened also. In anæmic subjects this end will not be attained so readily as in persons of tonic health, and hence the necessity of abstaining from copious depletion. When the sac hitherto soft and flabby becomes firm, a change that may occur at the expiration of a few days from the first application of pressure, we infer that the case is progressing favourably.

Under these circumstances, it will not unfrequently happen that the limb previously cold will regain its natural temperature. The laminæ of fibrin increase in thickness till, somewhat suddenly, and without apparent cause, the aneurism becomes exceedingly painful for a period of a few hours, and consolidation is the result. In fact, the disease is cured. The main artery perhaps retains its patency and continues to supply the limb until the case has progressed some way towards its cure, when collateral vessels in great number become developed about the tumour and the main artery is obliterated at the sac by the encroachment of the coagulum into its calibre.

Choice of tourniquet.

Every variety of tourniquet has been pressed into the service of this treatment, and much of the comfort of the patient, which is closely allied to the success of the case, depends on both the selection and application of the instrument. The Dublin surgeons employ an instrument invented by Dr. Carte, which consists of a frame-work fitting closely to the pelvis to which the double tourniquet is fixed, and they advocate pressure by means of elastic vulcanized india-rubber bands. The common tourniquet may be employed when no other form of this instrument can be obtained; or the Italian tourniquet, which possesses some good attributes for the purpose, but more bad ones. The principle of the tourniquet of Dr. Carte is embodied in the instrument which bears my name. It is, I conceive, sound in principle, and if carefully applied, will be found in all respects unobjectionable. The principle demands steady pressure, easily regulated without fear of displacement; and, secondly, that the pressure be restricted to the one line, viz., that under which the main artery passes, all the rest of the limb being left as free as possible. That the required breadth of the pad will involve both femoral vein and anterior crural nerve, in the treatment for popliteal artery, and the venæ comites, and the median nerve, in the case of brachial aneurism, cannot, I conceive, be disputed; but the important fact to be observed is, that no evil consequence arises from such pressure. There can be little doubt, however, that the greater the freedom left to the venous circulation in other parts of the limb the better, and hence the value of the two instruments I have referred to, as preferable to any others. For a more complete report of the treatment of aneurism by compression, see Dr. Bellingham's work on this subject, also a valuable paper of his in the "Medico-Chirurgical Transactions," Vol. 34. Mr. Tufnell's work on the subject, and my college lectures published in the *Medical Times and Gazette*, of 1854.

## TREATMENT BY LIGATURE.

It must be quite obvious from the foregoing remarks, that the treatment by compression, however available it may be in cases of aneurism, in which the above conditions apply, can never supersede that by ligature. It can be applicable only to disease of arteries which admit of the application of one, and if possible, of two tourniquets, such as chiefly the femoral and the brachial. It is of doubtful advantage in aneurism of the carotid artery, aneurismal at or about its bifurcation, and equally so with respect to the axillary artery, consequent on the depth of the subclavian trunk from the surface. Aneurisms of the external and internal iliac vessels also for obvious reasons preclude the resort to it. While in similar affections of the ternary branches of the arterial system, such as the radial and ulnar, posterior and anterior tibial, there is less objection to the use of the ligature. Some practical difficulty, however, may occasionally arise in cases of aneurism involving the identical vessels most commonly amenable to treatment by compression.

First, a peculiar irritability of system sometimes renders the subject of disease intolerant of the restraint of continual pressure. It may consist of a moral or corporeal inaptitude,—a temper ill-disciplined to restraint, and intolerant of suffering, that chafes and frets under continuous pain, however slight, in comparison with the good to be effected. Such a man, instead of aiding his surgeon, and co-operating with him in the treatment, suggests objections, raises difficulties, and by various devices which ill-conditioned minds are too prone to resort to, continually obstructs the progress of his treatment, while on the other hand constitutional irritability may prevail to the extent of causing erythema, and even erysipelas around the pad of the tourniquet. Such a case occurred to myself, and I was compelled to tie the femoral artery, after a second removal of the tourniquet, the slight preparatory pressure of which was followed by local erythema and swelling of the entire limb. Treatment by compression would not, I conceive, be desirable in a case in which the sac was unquiet; I mean, if there existed any tendency, and very especially, if a positive tendency to pain, or suppuration, or gangrene. In such cases we should at once resort to the operation by ligature as the sure method of bringing about an immediate crisis, by taking all the pressure of the circulation from off the sac, when the operation, then, is clearly indicated.

Oblique incision.

The line and direction of the artery being determined with exactness, an incision should be made over it, of a length proportionate to the depth of the vessel from the skin, but it should always be ample. This line is usually directed to be made parallel to the vessel beneath it; and although this rule has the sanction of the highest authorities in this country and on the Continent, I venture to suggest a doubt, whether an important modification of this practice may not be an improvement upon it. I almost invariably adopt an *oblique incision*, and generally at an angle with the artery of about 30°, on the following grounds: that in fat subjects it may be difficult to ascertain the exact line of the vessel, and that, however true the first incision may be, it does not follow in the course of a slow and bloody operation, that the same line will be preserved; that if, from accidental circumstances, the precise position of the artery be lost, the operator is equally uncertain whether he is dissecting on the inner or on the outer side of the vessel, or upon it; that, by dividing obliquely across the direction of the vessel, he acquires a confidence, from the conviction that the artery is really under his knife; and, lastly, that he makes an external wound, within which the ligature needle is more readily carried round the artery in a fat subject, in which the vessel lies deep, than in a wound parallel to it. The objection to a directly transverse wound is, that the artery is exposed only in a transverse line, and there is nothing gained, but much may be lost. In the femoral, brachial, radial, and ulnar, and posterior tibial, I consider the oblique incision to be an important element of success in finding the artery with facility. Take the example of the posterior tibial artery, how preferable is it, to make an external incision over this deeply seated vessel across the line formed between the muscles that surround it, than to endeavour to hit the exact line, where the deviation of one-eighth of an inch would carry the surgeon into the substance of either of two muscles, neither of which he would be able to distinguish from the other! I remember, many years since, to have seen a practised operator totally fail in his attempt to tie the ulnar artery immediately above the wrist, from this difficulty.

**Advantages of.**

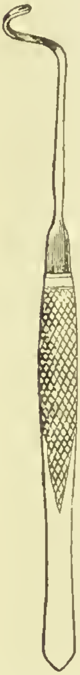
The sheath of the artery should be cleanly divided, and the coats of the vessel exposed, otherwise we cannot feel confident that we may not include any other structure but the artery itself. If necessary, the sheath may be divided on a director, but always to the smallest possible extent. Safety is our first consideration; display, if requisite, should follow at a considerable distance behind. The needle should be selected that will most readily effect its object, which, of course, is that of passing with

**Sheath divided.**

**Aneurismal needle.**

facility around the vessel. The edge of this instrument should be neither too acute nor too blunt. In the attempt to carry it round the artery, a slight force only should be employed. The instrument should be so finished as to be enabled to cut its way by a gentle lateral movement of the hand. If too acute it may penetrate the artery or the vein; if too blunt, it will require more force in its introduction than the delicacy of the operation justifies.

Of all the varieties of aneurism needle, from the common instrument bearing that name to the very ingenious invention of Mr Weiss, which, dividing into two parts, catches the ligature by a spring clasp, I prefer that here sketched, which is a modification of the needle invented by Mr. Alcock, but I conceive improved, by being carried out farther at the point than the needle in question.



**Artery not separated from sheath.**

The artery should not be unnecessarily separated from its sheath, from which it derives its vessels, the laceration of which, if considerable, may be presumed to be injurious; though I am inclined to think more importance has been attached to this principle than it merits. I am not aware of any example of positive injury, such as secondary hæmorrhage, that has been unequivocally traced to the operation of this cause, the evil of which would appear still less imminent, when we consider that the consequences of such separation between the artery and its sheath would, under nearly all circumstances, have ample time for the recovery of their natural relations, before the ligature would separate spontaneously from the artery by the natural process of ulcerative absorption. But this argument, although essentially sound, forms no justification for laying aside the rule above given, not to separate unnecessarily the artery from its sheath, because there is no necessity to do so, which alone is argument sufficient; but in opposition to all the experiments, and all the comments upon them, a case might occur in which such a proceeding may be injurious; and, at all events, it must be deemed a step in the wrong direction, and as such, is to be avoided.

**Superfluous**

The ligature being passed around the artery, should be drawn tight with a force sufficient to cut asunder the two internal coats. All force beyond this is superfluous. The thumbs should be employed for this purpose, around which the ends of the ligatures are drawn, while placed as closely as possible to the artery, with a view to prevent the unnecessary separation of the vessel from its sheath. When the ligature is placed around the artery, and before tying it, the surgeon should examine carefully the structure about to be included in it, and the attention of one or more assistants be called to the same observance. No professional attendant has a right to exempt himself from the responsibility of an opinion, if any doubt exist on the subject, as to the perfect or imperfect completion of the operation. Each should examine the relations of the ligature to the vessel, and express any doubt that may occur to his own mind, whether the vessel about to be inclosed in the ligature be really the artery, and whether any other structure than the artery be still in contact with it. One end of the ligature may then be divided, and the other end brought through the outer wound, to a length of about three inches beyond it. Over this end, a piece of plaster may be at once drawn, to protect it against injury. The wound may be united by the first intention, the edges being brought and maintained in exact contact. The period of time that will elapse before the ligature comes away, varies with the size of the vessel, and is always very uncertain. For the femoral, from fifteen to eighteen days will be required; for the brachial, some days less; for the radial or ulnar, from eight to ten days, and so on. The process of union of the opposite sides of an artery, and its consequent obliteration, is, however, not to be determined by the period of separation of the ligature, which may be protracted by other causes influencing a remarkable tolerance of its presence by the granulations within, to which it will occasionally cling with tenacity for many weeks. In his experiments on this subject, Mr. Travers has proved the removal of a ligature within even a few hours of the operation for applying it, may be effected with safety, and the entire obliteration of the vessel secured. But, as a general rule, it is better, because safer, to leave the ligature to come away by itself, unless the period be a good deal protracted, and then its presence becomes inconvenient, and attempts

tension of ligature.

Separation of ligature.

Ligature retained.

Means of separating it.

may be made to hasten its separation by artificial aid, such as winding the extremity around a roll of plaster, and by that means maintaining permanent extension of the thread, or by tying a thread of elastic material, such as caoutchouc, to the end of the ligature, and drawing it tightly round the limb, and fixing it with plaster. At the expiration of some weeks, during which the process of obliteration of the artery must have been completed, there will be little danger in making this attempt, yet it should not be resorted to earlier, nor would the high authority of Mr. Travers advise, or I presume adopt, such a proceeding, however conclusive his experiments on animals, and however sound his reasoning, in favour of the general safety of early separation.

Operation beyond the sac.

Cases requiring it.

An artery may become aneurismal in a part of its course, so near to a large branch, as to preclude the possibility of the passing a ligature around it with safety above the aneurism, or, in other words, between it and the heart. Under these circumstances surgeons endeavour to obliterate the vessel and its sac by means of a ligature applied around the artery, below the disease, instead of above it. The merit of this operation is supposed to belong to Brasdor, and it has been adopted by Desault, Deschamps, by Sir A. Cooper, more recently by Mr. Wardrop,* and Dr. Bush of New York.† It is not selected as being a more eligible operation than that usually resorted to for the cure of aneurism, but simply as an alternative in which the common operation is contra-indicated by local circumstances; viz., where the vessel has not sufficient length to admit of the formation of a coagulum between the ligature and the first great collateral branch above it. Such a condition will justify, and indeed compel, the attempt to obliterate the vessel by a ligature applied below, or on the distal side of an aneurism. Of the six recorded cases of this operation, four operations were performed on the carotid, and two on the femoral arteries, immediately below the groin. Both the latter proved fatal. The two successful operations were performed on the carotid, one by Mr. Wardrop and one by Dr. Bush.

* Wardrop on Aneurism, 1828.

† Dr. Bush's Case. See "Lancet," vol. i.

It is proved beyond a doubt, that a ligature applied around an artery on the distal side of an aneurism, is sufficient for the purpose of establishing a collateral supply of blood to the limb; nor does it appear that deficiency of supply of blood has attended any of the above cases. But it is, I think, obvious, arguing, however, from a somewhat limited experience, that the circulation generally and especially the sac, sustains a greater shock from the operation of Brasdor than that from which is justly termed the operation of Hunter. The impulse on the sac is great, the coats of the artery become damaged, and in one instance they ulcerated. The operation of Brasdor will only be resorted to in cases of necessity, and although these cases are not of very frequent occurrence, it will always retain a position among the resources of the surgeon in aneurismal disease. It is applicable only to arteries giving off no branch, like the carotid. The failure in both examples in which the femoral was tied high up, was probably due to the current of blood being continued through the epigastric and circumflexa ilii arteries, while it was performed by Mr. Wardrop and by Dr. Bush, on the trunk of the common carotid with perfect success.

Operation of Brasdor.

On the completion of the operation for aneurism, the patient being removed to bed, should be placed in a position of perfect rest. His diet should be low. There is usually no necessity to increase the quantity of clothing, or to anticipate any deficiency in the temperature of the limb, so rapidly is the collateral circulation established. Of the numerous untoward consequences enlarged on by French authors, as attendant on operations for aneurism, I know but of two. The first is, that the temperature of the limb is raised, as it is said, by reason of the increased cutaneous circulation; a not very important symptom, and greatly exaggerated by report, but which brings about its own re-action in the course of two or three days; and, secondly, in large operations for this disease performed on vessels near the heart, and on them only, the nervous system appears to sustain a shock which demands immediate attention. The symptoms occurring in the case of disease of the subclavian artery, in which I tied that vessel, were very formidable and even alarming. Violent pulsations against the ligature, and along the

Temperature of limb raised.

Shock of the nervous system.

course of the aorta, a sense of suffocation and of pressure, as though caused by the aorta, on the left lung. But these symptoms, more formidable than any I had witnessed, either before or since, yielded to sedatives and antispasmotics. Nor is it surprising that an operation which has exposed a structure so intimately concerned with, and so proximate to, the heart itself, the susceptibility of which, even under natural excitement, responds so readily to every motion to which thought can give rise, should give rise to considerable constitutional disturbance.

Violence done to the vessel.

I am inclined to believe, that it is to this violence done to an important blood-vessel, rather than to the throwing back on the heart the hitherto circulating blood, that these symptoms are due. In Dr. Mott's case, in which he tied the innominata, not the slightest indication of suffering by the heart followed the application of the ligature, which might be expected to attend the operation immediately, and, indeed, the nervous symptoms to which I allude do not usually commence until some hours after the artery has been tied. The same absence of symptoms atttended Graefe's operation in Berlin, though it was followed by great constitutional irritation and fever. In speculating on this subject, perhaps, we do not always remember that the circulation in the limb is a good deal reduced before the operation, as characterised by the coldness of the integuments.

Gangrene.

Gangrene is an occasional, though a very rare attendant on operations for aneurism in this country. It would appear as a more frequent result of similar operations in France. Under any circumstances its extension can only be met by amputation. It usually commences at the extremity of the limb, and every means should be employed to arrest it. Stimulants, nutrient food, and artificial warmth should be resorted to most sedulously. The part should be covered with hot flannels, and warmth applied to the distal surface. If these and similar agents fail to arrest its progress, and to stimulate the enlarged vessels to more active duty, the preservation of the limb becomes hopeless.

Treatment.

The decision as to the place for amputation is a difficult one. If the gangrene proceeds with rapidity and extends up the limb, amputation should be performed very little below the ligature of the former operation; but, on the other hand, if the progress be slow, if the temperature of the limb retain that of the rest of the body, at least to within a short distance of the gangrenous surface, the removal of the limb may be postponed, and eventually as much of it retained as may be conducive to the future wants and necessities of the patient.

Treatment by manipulation.

In a paper published in the 41st Vol. of the Medical Chirurgical Society, Mr. Fergusson has given an account of two cases of aneurism, which he treated on a totally new principle from any hitherto adopted. Mr. Fergusson proposes to disengage a portion of the fibrous contents of the sac by rubbing or by pressure by the finger or hand, to bring such portions within the range of the circulation, with the intention of filling up the artery beyond the sac. If this object can be obtained, the free current of blood through the vessel on which the aneurism is formed is arrested, and the sac will become insulated from the circulation, and be eventually absorbed. Such is the proposal, and it now remains to be shown how far success attended the experiment performed by Mr. Fergusson in the two cases, the particulars of which he has given in the above paper. In the first example, a case of subclavian aneurism, Mr. Fergusson pressed the sac with his thumb. This operation was followed by symptoms involving the cerebral circulation, from which the gentleman however quickly recovered. The manipulation was repeated at the expiration of a week, but with more caution. The result was great diminution in the pulsation of the arteries of the arm below, and some reduction in the size of the sac. Notwithstanding which the patient died in the course of about eight months.

In the second case, in which disease also existed in the right subclavian artery, manipulation was followed by hemiplegia, but the man eventually recovered. It would I think appear from the consideration of these circumstances common to the two cases, that no doubt can reasonably exist of the separation from the mass of a portion of the fibrinous contents of each sac, possibly a mere fragment, minute parts of which must have been carried up to the brain, and there produced sudden arrest in the circulation of the vessels receiving them,*—whether at the expense of rupturing other vessels or not we do not know. The general belief of professional men would be, I conceive, favourable to such doctrine, but this evidence is very uncertain and inconclusive. These considerations present themselves to the mind of the surgeon; 1st, whether such manipulation, occasioning a sudden change in the composition of the interior of the sac of an aneurism, can be obtained by the means proposed; 2ndly, whether such end being obtained can be rendered productive of benefit by blocking the artery beyond the sac, and thus insulating the aneurism from the circulation; and 3rdly, whether the proceeding can be adopted without danger to the life of the patient.

---

* As under other circumstances; in the manner first pointed out by Virchow and Kirkes.

As regards the first question, nothing but a separation of a portion of the contents of the sac can explain the consequent phenomena. In the first case the circulation in the arm was arrested almost from the moment of the application. By what means could such arrest take place, but by the sudden blocking up of the main artery below the aneurism, and by what material, but by fibrin obtained from the sac? 2ndly, Can such a proceeding be rendered productive of benefit to the subjects of aneurism? While it must be confessed that the first experiment of Mr. Fergusson terminated unsuccessfully, yet it cannot be denied that the history of the case subsequent to the operation, involved many conditions which a surgeon would desire to see attendant on his treatment on former principles, viz.: diminution of the sac, and arrest of the circulation in the secondary arterial branches below the aneurism. Nor can it be doubted that for some time the case gave promise of a successful issue. 3rdly, Can the proceeding be adopted without danger to the life of the patient?

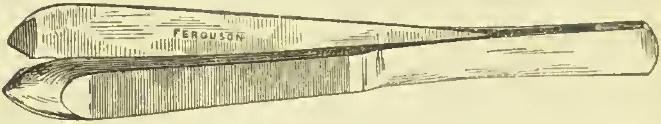
It must be recollected that subclavian aneurism is itself a source of great danger to life under all conditions, and therefore we are not to estimate its amount in such a case as though it were calculated on the life of a person in health. Therefore are we warranted in encroaching beyond the line of danger to effect a cure? In the report of the cases in question, it would appear that, however judiciously each operation was executed, yet the addition of more caution might have favourably influenced the results of both. For example, it might have been instrumental to a good end if the trunk of the diseased vessel had been compressed between the aneurism and the heart during the process of manipulation of the sac. Firm pressure over the scalenus anticus will materially influence the circulation below, and the escape of fibrin in the direction inwards prevented. It must be allowed that the symptoms in each case were sufficiently alarming, and go far to prove that the treatment by manipulation should never be resorted to so long as treatment, whether by pressure or by ligature is available. On such conditions, it appears to me that the evidence already afforded furnishes matter for much and interesting inquiry, and that it may hereafter become the agent of much practical good.

## ON THE TYING OF ARTERIES DIVIDED IN WOUNDS AND AMPUTATIONS.

Necessity for tying all bleeding arteries.

In another part of this chapter it has been stated, that vessels, when first divided by the knife of the operator, bleed most freely, contract in the course of a few minutes, and during the process of preparing the wound for the application of plaster or suture, are scarcely recognized; the principle has also been strongly urged, that, if we desire to effect early and permanent union between opposite surfaces, it is indispensable that we bring them into contact when freed from the interposition of coagulum, and that the presence of blood, whether in a cogulated or in a fluid state, is fatal to union by the first intention or by direct adhesion. Great attention, therefore, should be bestowed on securing all the divided arteries that are likely to bleed, for the warmth of the bed will promote the return of hæmorrhage from vessels that have ceased to bleed while the wound is exposed to the air. We must not, therefore, be content with applying a ligature around the larger vessels only, but grapple with them all, and prevent not only bleeding, but oozing of blood. In the case of a stump after amputation, every artery should be sought for, from which blood may trickle, for the quantity may increase, after the edges of the stump are brought together, or a coagulum may form, and the adhesive process become interrupted.

In the tying the bleeding arteries of a wound, we usually select the largest for the first ligatures. In stumps, the main artery is always first tied, the ligature silk for which should be strong enough to bear considerable effort of tension; and in which a knot may be tied, for the purpose of identifying it. Other arteries may then be secured, either by being caught by the common forceps, of which a modification is here represented, invented by Mr. Luke, of the London Hospital, and adopted by Mr. Stanley, or by Assalini's forceps, or by a tenaculum. If this latter instrument be employed, care should be taken in this, as on all occasions, to raise upon the instrument as small a portion of muscle as possible. It occasionally happens that, notwithstanding our best efforts, oozing of blood still continues. It may proceed, in the case of stumps, from the medullary artery, which is very difficult to arrest, from its having retracted within the sawn margin of the bone. In that case, if the pressure of the finger with some flue of lint, or the agency of cold air, by exposing it freely, and a reasonable allowance of time, fail in the object, the patient should be removed to bed, and the wound left open for some hour or two. The vein also is a frequent source of difficulty. It should be met by removal of the tourniquet, elevation of the limb, and the influence of time, accompanied if necessary by pressure on the orifice. A few minutes will generally serve this purpose. If the bleeding still continue, a ligature may be applied around it. In the tying of arteries in stumps, or other wounds, sufficient force has been applied, if the inner coats of the vessel have been simply cut asunder; any tension beyond this only endangers the ligature, and can answer no useful purpose whatever.



Medullary artery.

Arteries to be tied clean.

Where it is proposed by the operator to endeavour to heal a wound by the first intention, or indeed, under any circumstances, too much care cannot be bestowed on the mode of tying the smaller vessels. The forceps should be finely pointed, and be so applied to the mouth of the vessel, as to include the artery alone, and not the surrounding muscle or other tissue. In this respect, the forceps are less objectionable, if well made, than the tenaculum, the curve of which is so large as to pierce the muscle at some distance from each side of the artery, and a large piece of the muscle is thus coarsely included in the ligature. It is, perhaps, superfluous to say, that this portion sloughs, and becomes a source of irritation hereafter.

It will greatly facilitate the application of the ligature, if, when about to be drawn tight, the forceps be laid down on the surface of the stump or other wound, and thus held at a right angle to the vessel. By this movement the ligature may be kept free from the point of the forceps.

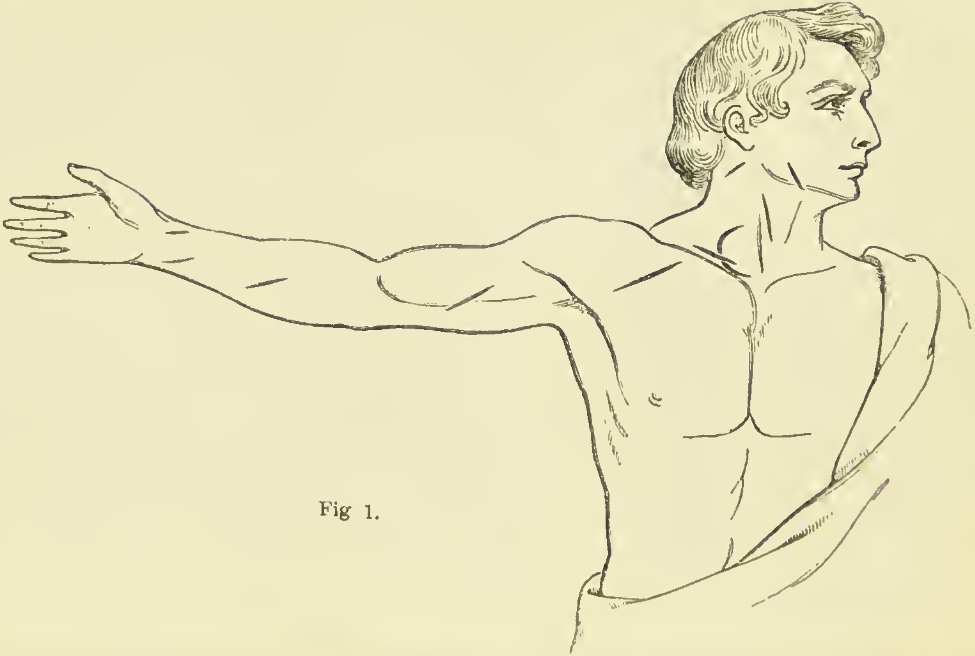


Fig 1.

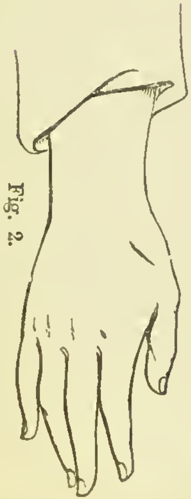


Fig. 2.

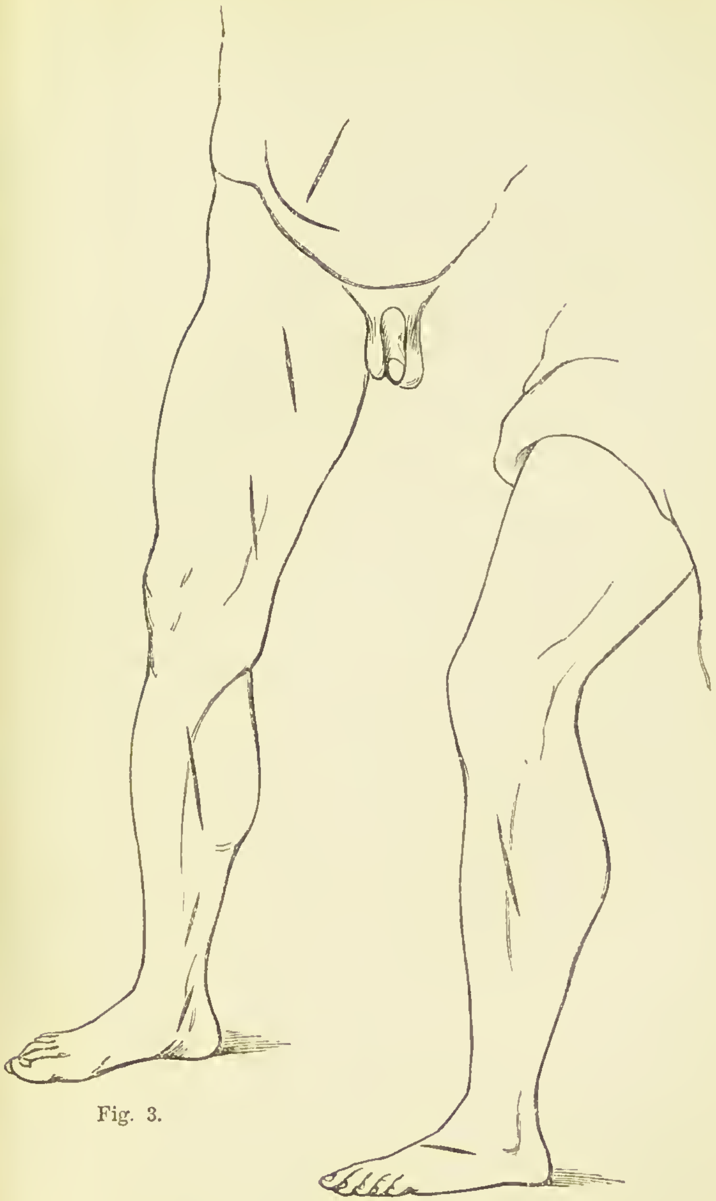


Fig. 3.

Fig. 4.

## ON ANEURISM OF THE ARTERIA INNOMINATA.

The arteria innominata is from fifteen to eighteen lines in length. It is placed behind the first bone of the sternum, from about the middle of which it ascends in an oblique direction to the right sterno-clavicular articulation, where it terminates by its division into the carotid and subclavian arteries. The extent of its elevation above the upper edge of the sternum varies much in different individuals. In many, its pulsation is quite apparent to the extent of half an inch, or even more; while in others, no part of it is perceptible on pressing the finger into the supra-sternal fossa. I think I have observed the innominata to be more elevated in its position in young subjects, in whom its pulsations are more palpable above the level of the sternum, than in adult age. It is separated from the sternum by the left vena innominata, which crosses it nearer to its origin from the aorta than to its division above, and, by the sterno-hyoid and thyroid muscles. The artery lies closely in contact with the trachea behind, and is placed obliquely upon it. The right pleura is not in immediate relation with the artery, but lies to its right side (*i.e.*, the right of the individual). The right pneumo-gastric nerve is placed more than half an inch from its right side; and neither of these objects ought to be exposed in the operation for tying it.

Relative anatomy of.

Aneurism of the arteria innominata consists in a simple dilatation of the artery, involving its three coats in a greater or less degree; but it contains no coagulum, for it is a dilatation of the entire vessel. It may be distinguished from aneurism of the arch of the aorta, by its pulsations being more elevated towards the neck. Aneurism of the upper part of the aorta involves the sternum, which is gradually absorbed to the extent of two or three inches down; it conveys an aneurismal thrill throughout the head and each of the upper extremities; whereas, that of the innominata is confined to the right side. Aneurism of the aorta, when of large size, is not a dilatation of the vessel, nor a true aneurism; but a false aneurism, in which the sac communicates with the vessel by a contracted opening, through which blood enters and

Diagnosis between aorta and innominata.

coagulates. This sac increasing, comes into contact with the sternum and absorbs it. In that of the innominata, the disorganization of structure is less in degree, both from its nature and from its locality. In the latter disease, dyspnœa is of more frequent occurrence, than in that of the aorta, from its proximity to the trachea. Often this symptom, however, is only occasional; it subsides and reappears under excitement.

In the advanced stage, a difference may be perceived in the condition of the venous circulation of the two sides of the neck, in consequence of the pressure on the left vena innominata by the artery against the sternum. If pulsation, morbid in degree, be felt on applying the finger to the upper part of the sternum, between the sternal attachments of the mastoid muscles in the *early stage* of the disease, the arteria innominata will be its seat, and not the aorta, for the aorta to have reached that level, infers disease of some standing; and, supposing the latter vessel to be the subject of aneurism, the sternum must be involved. A case in point came under my charge, in St. Bartholomew's Hospital, last autumn. A woman, aged about thirty-five, was admitted with supposed aneurism of the innominata. A tumour occupied the front of the sternum, to the extent of about two inches. She suffered little from dyspnœa; the radial arteries pulsated with force, and with the like characters. Although the tumour appeared also above the level of the upper edge of the sternum, and encroaching on the neck, it did not take the oblique line of the arteria innominata, extending towards the right, but occupied the middle of the neck, in the supra-sternal fossa. In the opinion I had formed, Mr. Lawrence, who had subsequently charge of the case, concurred. The woman died in the following December, without rupture of the sac. The disease occupied the upper part of the arch of the aorta, and the innominata was healthy.

Case.

Cases of spontaneous obliteration of the innominata are well known to the profession. A case is reported by Pelletan, and a second, by M. Darrach, in which the obliteration extended to the carotid and subclavian vessels, by which all doubt as to the power of the collateral circulation was removed. The conviction of the truth of this fact, and the necessity of the attempt to

Spontaneous obliteration.

prolong life in disease of the lower portion of the carotid artery, or of the inner part of the subclavian has led to the operation for tying the innominata. This operation has now been performed in four or five cases; and, although hitherto no single case has proved absolutely successful, yet life has been prolonged to a period which argues the great probability of future success, should the operation be repeated.

Ligature around the innominata.

Dr. Mott.

It was first undertaken by Dr. Mott of New York, in the year 1818. This patient survived to the twenty-sixth day. The second case, performed by M. Graefe, of Berlin, died on the sixty-seventh day. Both patients died of ulceration of the artery, and in both cases a coagulum was formed in the innominata below the ligature. The application of the ligature was unattended by any serious symptom, and the right arm and neck obtained an ample supply of blood. The same result attended a case operated on by Mr. Liston, in which he tied both carotid and subclavian close to their origin from the innominata. Here, also, a clot formed in the latter vessel, below the ligature. I do not understand the assertion of Mr. Liston, that in a ligature on the innominata, "there is little chance of a coagulum forming on either side of the ligature." This patient also died of secondary hæmorrhage.

M. Graefe.

Mr. Liston.

## OPERATIONS FOR TYING THE ARTERIA INNOMINATA.

The patient should be placed on a table, with his head directed obliquely towards a side window, admitting a sufficient quantity of light, or in a room lighted by a skylight. The head should be thrown backwards for the purpose of rendering the front of the neck sufficiently tense. An incision of at least two inches in length should be made along the anterior margin of the *left* sterno-mastoid muscle (see Fig. 1). The parts underneath this incision are to be carefully divided, including the cellular tissue and the cervical fascia, of which two laminæ may be exposed. At this stage of the operation the patient's head may be raised on a pillow, with a view to relax the parts hereafter to be exposed. The sterno-hyoid and thyroid muscles are now brought into view. In dividing the right muscles, great care should be taken to avoid a plexus of veins, descending from the thyroid body and the middle thyroid artery, should it exist, which are placed immediately behind them. If these veins be unusually large, they will present a serious obstacle to the progress of the operation; and should the depth and narrowness of the wound harass the operator, he should immediately resort to a second incision, made along the line of the right clavicle, detaching also the sternal origin of the mastoid muscle from the bone. An assistant should be occupied in retaining asunder the opposing surfaces of the wound, by efficient retractors; not the edges merely, but on the right side the sterno-mastoid muscle, and on the left, all the structures down to the exposed trachea. From this stage of the operation there is no warrant for the use of the cutting-knife, which may be laid aside. The patient should be directed not to swallow. By means of a silver knife, the portion of the sterno-thyroideus below the part divided may be dissected from its under surface, and the left vena innominata will be brought into view. The silver knife, also employed in like manner at the lower part of the wound on the right side, will expose the origin of the common carotid, along which the finger should be passed downwards. As the ligature is to be passed around the artery above the part crossed by the vena innominata, which is near its origin from the aorta, no great difficulty arises from its presence; yet it must always be recollected that cadaveric dissection gives a very imperfect idea of the size of veins actually engaged in the service of the circulation.

Thyroid veins.

Silver knife.

The artery being exposed by the cautious separation of the cellular tissue around it, the needle should be applied to its right side, as close as possible, for the purpose of avoiding the right vena innominata, and carried closely round the back of the artery, to avoid filaments of the cardiac nerves, one of which, however, descends on its anterior surface.

It is presumed that the reader is aware of the great irregularity attending the origin of the branches from the arch of the aorta. Should such irregularity prevail in the case under operation, the operation should still be carried on to its conclusion, as no ordinary variety would militate against it. If two vessels arose from the arch,

Irregular origins of vessels.

instead of the single innominata, the ligature would necessarily be placed around the vessel pointing to the aneurism. If the middle thyroideal artery exist, it must be exposed during the operation. Should it appear to come from the innominata, a ligature should be passed around it. It does not, however, frequently exist at all, at least not more than once in eight or ten persons, and then usually arises from the arch of the aorta.

The artery may be tied at a distance of a quarter of an inch from its bifurcation. The wound carefully cleansed of coagulum, if necessary, and the sternoid muscles replaced, may be united by suture, and adhesive plaster; one end of the ligature being brought out through it to the length of two or three inches.

For this operation four assistants are requisite; two of whom will be directly engaged in the operation. The instruments required are scalpels, forceps, a silver knife, a well-made and firm director, and a flexible director, two pairs of retractors, with handles of sufficient length to prevent the hands of the assistant from obstructing the movements and operations of the principal, and three or four kinds of aneurism needles, two kinds of ligature silk, the largest kind of which should be employed for the artery, and a finer ligature for any wounded vein, or minute arteries, should it be deemed requisite to tie them.

Instruments required.

Venous plexus.

The greatest difficulty, I apprehend, in this operation, consists in the presence of the really large veins, forming a thyroideal plexus upon the trachea; one of which was divided in Dr. Mott's case, materially obstructing the progress of the operation. Should it be necessary to make the division of the origin of the sterno-mastoid muscle from the clavicle, as well as from the sternum, great care should be bestowed in the division, lest the transversalis colli vein be wounded. The division should be made slowly, from above downwards. A branch from the transversalis colli artery often enters the sterno-mastoid muscle near its origin.

## OPERATIONS FOR TYING THE SUBCLAVIAN ARTERY.

Relative anatomy of the subclavian artery.

From the summit of the arteria innominata, the right subclavian proceeds upwards and outwards, to the upper border of the first rib. On passing over the rib it is covered by the scalenus anticus muscle. It then bends downwards, and at the lower border of the rib it receives the name of axillary. The first portion, placed on the inner or tracheal side of the scalenus, is about one inch in length; the second portion, or that behind the scalenus, about three quarters of an inch; the third portion, or that on the outer side of the muscle, is also about an inch. The two subclavian arteries correspond in their course in the second and third stages, but not in the first. On the right side the subclavian, in its first stage, rises obliquely, at an angle of about 45° to the vertical line. It is placed in front of the root of the right lung; it is crossed by the pneumo-gastric nerve; the right vena innominata descends in front, but to the right side of it. The internal jugular vein crosses it, close to the scalenus. The first stage of the left subclavian artery is placed longitudinally, arising from the arch of the aorta; diverging a little from the left carotid, it ascends from behind the left pleura and lung, nearly in a vertical direction, having the corresponding pneumo-gastric nerve nearly parallel to it, and on its right side. The left vena innominata crosses, three or four lines in front of it, close to its origin from the aorta. Its length is about two inches.

In the second stage of their course, the subclavian arteries pass behind the scalenus anticus, on the front of which the phrenic nerve is closely adherent, descending along the line of the muscle into the chest. In the third stage, the subclavian vein lies close in front, but below the artery; and the axillary plexus of nerves is placed immediately above and behind it. The lowest branch of the plexus has been repeatedly tied, in place of the artery.

From the first or inner portion of the subclavian artery, there arise three large branches; viz. the vertebral, internal mammary and thyroid axis. Two smaller vessels also arise from it when passing behind the scalenus; viz. the cervicalis profunda, and superior intercostal. Of these branches, the thyroid axis produces two secondary branches, the transversalis colli, and supra scapular, which, crossing the scalenus muscle and phrenic nerve, enter and pass transversely across a triangular space, almost parallel to the main trunk. This small triangle is formed by the outer side of the scalenus, by the omohyoideus, and the base is completed by the first rib.

Signs of aneurism.

Aneurism of the subclavian artery is a rare disease, when compared either with that of the aorta, or with that of the axillary artery. The part of the vessel least exempt from morbid changes is the third stage of the vessel, or that lying on the first rib. A pulsation is felt in this situation of a true aneurismal character, commencing clearly above the clavicle, and occupying the space between the clavicular border of the mastoid muscle and the anterior edge of the trapezius, influencing the circulation of the arm, so as to render the pulsation in all the vessels of the fore-arm more or less indistinct. As the disease advances, the aneurismal tumour rises up in a conical form, projecting considerably above the level of the clavicle. The arm then becomes benumbed, and sensation is imperfect. The fingers are pale or livid, as the circulation becomes more and more interrupted, while the numbness in the limb is the result of pressure on the axillary plexus, lying side by side with the trunk of the artery.

Mr. Colles's case.

In Mr. Colles's case the right subclavian artery was tied on the inner side of the scalenus, for aneurism of that artery beyond the scalenus. The operation was a protracted one. The ligature was not tightened till the fourth day. The patient died on the ninth. If the disease for which this operation was performed had been submitted to Mr. Colles's observation at an earlier stage, and before it had so largely encroached on the supra-clavicular region, he would have adopted the less complicated operation, and probably with a more successful result.

Necessity of an early resort to operation.

In operations upon the subclavian artery, judging from the almost unvaried failure that has followed the attempt to obliterate the artery, by applying a ligature around it on the inner or tracheal side of the scalenus muscle, it is of the utmost importance in these cases of disease of the subclavian artery in its third stage, to tie the vessel on the outer side of the scalenus, before the tumour has reached a size sufficiently great to occupy the entire space up to the level of the scalenus muscle. Subclavian aneurism more frequently commences at a distance from that muscle, than close to it, and by an early operation, the artery may be secured on the external side of the muscle. Of late years the subclavian artery has been repeatedly tied with success for axillary aneurism, in which the disease occupies the higher part of the axillary cavity, extending upwards from the subclavicular into the supra-clavicular regions. The operation for tying the artery on the inner side of the scalenus, corresponds so closely with that on the innominata, that further detail would be superfluous.

In aneurism of the innominata, the operation of Brasdor has been successfully revived by Mr. Wardrop.*

**Division of scalenus anticus.**

If the disease of the subclavian on the outer side of the scalenus do not encroach too closely on the muscle, an attempt may be made to tie the artery while passing behind it. This operation was suggested by Dupuytren, and requires an external incision, which will necessarily include the clavicular portion of the mastoid muscle. Its difficulty consists in dividing the scalenus without injury to the phrenic nerve, and the two arterial branches of the thyroid axis that usually cross this muscle. If this attempt be practicable, it is very preferable to the operations practised on the first stage of the subclavian, and most especially on the artery of the left side, which is one of the most—if not the most—difficult operations on the arterial system. I know of no case of its successful result on record.

**Mr. Ramsden's case.**

In 1809, the subclavian artery was first tied in St. Bartholomew's, by Mr. Ramsden, for axillary aneurism. Great difficulty presented itself in the attempt to turn the needle round the artery, consequent on the limited size of the wound, combined with its great depth. The patient lived five days, and died from exhaustion. In 1811, the artery was again tied for axillary aneurism, by Sir W. Blizard, without difficulty in passing the needle round the vessel. The subject died on the fourth day.

---

* See Wardrop on Aneurism.

The first successful case occurred to Dr. Post of New York, who tied the subclavian artery for axillary aneurism, in 1817, and a second case in 1820: it was also successfully performed for the same disease by Mr. Liston. Within the last thirty years it has been performed, with a varied result, by many eminent surgeons, both in England and abroad, but in the aggregate of which, the ultimate recovery of the patient has not predominated.

### OPERATION FOR TYING THE SUBCLAVIAN ARTERY ON THE OUTER SIDE OF THE SCALENUS MUSCLE.

Operation.

The patient should be seated in a chair, reclining backwards. This position is so preferable to the horizontal one, that although nearly incompatible with the employment of chloroform, it should be adopted. If possible, the trunk of the patient should be in some manner further supported, to prevent the consequences of possible syncope. The abdomen should be fixed by a broad roller to the back of the chair. It is recommended that an incision be made from two to three inches along the line of the clavicle, including its middle, and the outer portion of its inner third (see Fig. 1), the integuments over which should be forcibly drawn downwards by the left hand of the operator. When the tension is removed, the incision is found to occupy a line of about half an inch above the clavicle. Some difference of opinion appears to prevail on the necessity, or otherwise, of dividing the fibres of the mastoid muscle. Mr. Hodgson considers this division will not facilitate the progress of the operation. Mr. Aston Key made this division, as he conceived, with great advantage, in a case under operation. The truth is, that the necessity for dividing the fibres of this muscle will mainly depend on the extent of its attachment to the collar-bone. It is no infrequent occurrence, to find the mastoid and trapezius muscles investing almost the entire length of the bone, and I have repeatedly found the two muscles in contact nearly at its centre. Under similar relations the necessity for dividing not one only, but both these muscles, becomes indispensable; and as a general

Division of fibres of the mastoid muscle.

rule in the performance of this operation, I confess I am inclined to differ from the opinion entertained by Mr. Hodgson on this subject.

The upper edge of the wound should be now raised, and the platysma completely divided. The edges should be drawn asunder and the base of the wound carefully dissected, and the strong fascia of the region being divided, the omo-hyoideus will be brought into view at the upper part of the wound. The finger should now be applied for the purpose of ascertaining the exact locality of the artery, which is readily detected by its pulsation when felt; the cellular sheath around it may be carefully divided, and the parts rather torn asunder than cut. When this process is completed, the scalenus muscle, the artery, and the lower branch of the axillary plexus will be brought into view. The nerve lies above the artery and the muscle internal to it. If the cellular tissue on the front of the scalenus be pressed inwards, the phrenic nerve will be exposed. The facility with which a ligature will be passed underneath the artery depends on two causes: first, the degree of elevation of the shoulder, consequent on the advanced stage of the disease of the axillary artery, and, second, on the dimensions of the wound. The first difficulty is a very large one, and to it, in some considerable degree, may be ascribed the length of time occupied, and the obstruction met with, by so many operators on this vessel. The artery lies at the bottom of a contracted wound, triangular in form, the apex of which is represented by the artery itself, and the base by the first incision, and of which the depth may be three inches or more. Under usual circumstances, when free from disease, the subclavian artery at this place lies one inch and a half from the surface, and if the length of the first incision be limited to the interval of the mastoid and trapezius muscles, the difficulty of passing a ligature around the artery must be great indeed. The records of past operations point, however, to a great variation in the degree of this difficulty. In Mr. Ramsden's case it was almost insuperable, and the same evil has beset the path of other surgeons, by whom, however, it has been met by improved mechanism, and by maturer preparation.

Difficulty of passing the ligature.

Depth of the artery in health.

On the length of the outer wound, and on the means

Outer

wound as large as possible.

of making it of sufficient length, the surgeon should bestow his best attention. The narrow limits afforded to the operator by the above incision have always presented to my own mind a positive objection to this form of operation, and a case requiring a ligature around the subclavian artery, in the year 1841, enabled me to test, on the living subject, the superiority of a different form of external incision. The incision I refer to, instead of being nearly parallel, is almost transverse in its relation to the artery, and renders any considerable division of the mastoid muscle needless. The incision is made in an arched form (*see* fig. 1), and is commenced about two and a half or three inches above the clavicle, upon, or immediately on the outer edge of, the mastoid muscle. This incision is carried slightly outwards and downwards, towards the acromion, and then curved inwards, along the clavicular origin of the mastoid muscle. Its extent in the direction of the acromion must depend on the situation of the external jugular vein, the course of which varies in different individuals. This vein crosses the mastoid muscle in an oblique course, downwards and outwards, and dips in behind the clavicle, at a distance from the outer border of the clavicular origin of the muscle, varying from half an inch to an inch and a half. It is desirable to avoid it, in either form of operation, although no evil has arisen from its division in that usually practised. Should the jugular descend along the outer border of the muscle, which is not common, either the vein must be divided, or the flap be dissected from off it. When the flap is reflected sufficiently inwards with the platysma muscle, and the cervical fascia and cellular tissue separated, by being torn asunder, the subclavian artery is seen emerging from behind the scalenus and entering the triangle bounded by that muscle, the omo-hyoideus, and the first rib, and the lower branch of the axillary plexus and the transversalis colli are exposed to view. In this form of the outer wound, the difficulty of passing a ligature round the vessel is, I conceive, considerably lessened, in consequence of its direction being transverse to the course of the artery, and sufficient space is obtained for the introduction of the needle beneath the artery. A small portion of the clavicular origin of the mastoid muscle may be divided if necessary. The difficulty of

Operation performed by myself.

Jugular vein.

Ligature more easily applied.

the operation is but little increased, even supposing the interval between the mastoid and trapezius muscles to be limited, for the incision runs, as it were, parallel, rather than transversely, to them. I conceive also, that benefit is obtained by an incision which does not involve the venous system of the parts divided, the evil of which, if not considerable as regards the question of loss of blood, is sufficiently great in reference to the necessary obstruction to the progress of the operation, by filling the wound with blood, and, assuredly, the vertical arched incision I recommend, has this advantage.

Less venous hæmorrhage.

The above case of aneurism has not been published, and I proceed, therefore, to detail it from notes taken at the time, excluding such particulars as are irrelevant to my present purpose.

Case of subclavio-axillary aneurism, treated by operation.

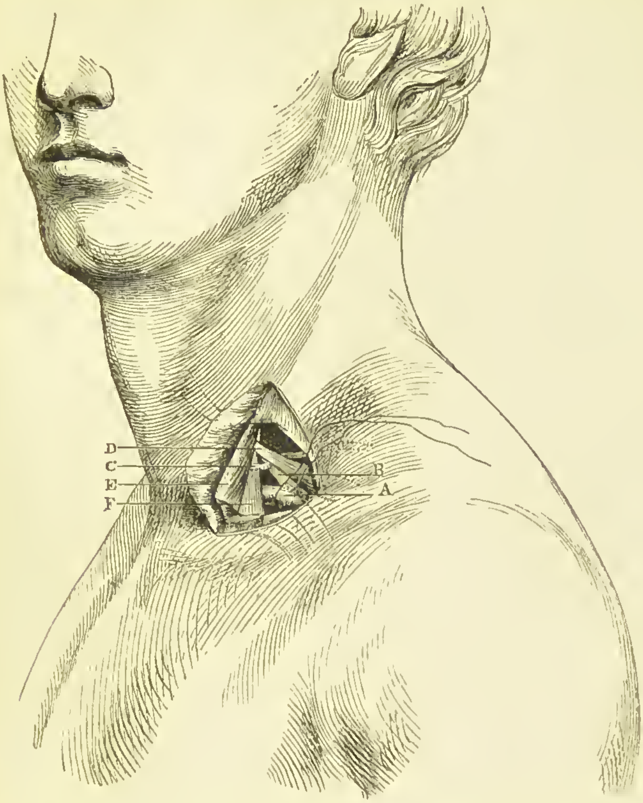
In the month of January, 1841, I was consulted by the Rev. Mr. P——, for numbness of the left hand and arm, which had existed for a period of about two months. He had observed it also to be more susceptible of cold than the opposite limb, and that it required the application of artificial warmth to enable him to use it while dressing. The hand was pale, more especially that part which is supplied by the median nerve, the little and ulnar half of the ring-finger being affected in a less degree. No pulsation was felt in the radial artery. The brachial artery, especially at the lower part, beat languidly, and pain was felt in pressing the finger along the track of the vessels. Above the clavicle, just half way between the two extremities of the bone, I perceived a small tumour, pulsating synchronously with the heart, about the size of half a hen's egg. Its contents were partly fluid and partly solid. Pressure on the tumour reduced it greatly in size, and stopped the circulation in the brachial artery. I could trace the line of the trunk of the vessel above the tumour, to the extent of three-quarters of an inch upwards, to the scalenus muscles.

On the following day a consultation with Sir B. Brodie determined the necessity of an early operation, and in this opinion Mr. Travers also concurred.

On Mr. P——'s return to town, after a necessary absence of four days, I found the tumour had increased one-third in size, and the numbness in proportion, and it had encroached in the same degree on the trunk of the artery above. He suffered considerable pain along the side of the neck and arm, particularly when in a recumbent position. The peculiar situation of the aneurism, involving the portion of the vessel which lies on the lower edge of the first rib, and yet more subclavian than axillary, and the positive advance of all the symptoms during the short period of four days, determined me to perform the operation immediately; for I considered, that if deferred, sufficient space would not be left to apply the ligature with safety around the artery, without detaching or dividing the scalenus anticus muscle, a course I did not look upon with indifference, notwithstanding its recommendation by Baron Dupuytren.

I performed the operation on the 26th of January, assisted by Sir B. Brodie and other gentlemen.

I commenced an arched incision about three inches above the clavicle, close to the outer border of the sterno-mastoid muscle, and carried it a little outwards, curving it in towards the clavicular origin of the muscle (*see* fig. 1), which I exposed to somewhat more than half its length. This flap, convex towards the acromion, I reflected inwards with the platysma muscle. A little careful dissection with a blunt silver knife exposed the lower belly of the omo-hyoideus muscle, and a portion of the sac, through the walls of which the pulsations of the artery were visible. On the inner side of the base of the wound, the external border of the scalenus was also exposed, and by tearing away the cellular tissue in this space, by means of a blunt hook and a silver knife, the transversalis colli and supra scapular arteries were brought distinctly into view, arising from the thyroid axis within the scalenus muscle, and proceeding outwards across the wound to their destination. Above the transversalis colli was felt the subclavian artery, and above the artery were seen the lower branches of the axillary plexus of nerves. The vein was not seen. I divided the cellular tissue covering the artery, fairly exposed it, and found it perfectly healthy. Having slightly detached it from the rib, I had no difficulty in passing around it an armed needle, and encircling the vessel with a ligature at a quarter of an inch on the outer side of the scalenus. On pressing the artery at the situation of the ligature all pulsation in the sac ceased: I then tied the thread. The operation was completed within ten minutes. The quantity of blood lost did not exceed one drachm.



A. Subclavian artery. B. Brachial plexus. C Transversalis colli artery. D. Omo-hyoid. E. Sterno-mastoid (reflected). F. Scalenus.

Two hours after the operation, Mr. P —— complained of a sense of pain in the region of the sac, and of the ligature about the artery, and shooting pain towards the heart, and along the external jugular vein, difficulty of swallowing, and pain down the inner side of the arm. The temperature of the limb was somewhat increased. Pulse during health 58, now 70. Two hours later, catching of the breath, with frequent sighing. Considerable difficulty of swallowing, as though caused by the presence of some body pressing upon the œsophagus in the situation of the origin of the subclavian trunk from the aorta. This sensation he described most precisely. Pulse 84 and full. Nervous symptoms.

These unpromising symptoms remitted under the influence of a large dose of nitre, and tincture of henbane. His body was bedewed with perspiration, and his breathing became more regular. The temperature of the limb was still increased above the natural standard. He perspired copiously through the night, which was passed without sleep.

Dyspnœa. On the following night he was again attacked with difficulty both of breathing and of swallowing, and pain along the arm. I repeated the nitre and henbane. Bowels relieved by injection. On the third day he suffered from continued cough, with difficulty of breathing: his countenance was anxious; his sense of weakness was very great. Tincture of henbane one drachm. On the fourth day, had slept for three hours. Cough. Had awoke with night-mare, and a tingling sensation in the left hand. He was now placed on a water bed, to which may be attributed a severe attack of general rheumatism, accompanied by pains about the loins and sacrum, and shooting pains down the legs. Colchicum and Dover's powder prostrated him. His urine became very high coloured and scanty. He was removed on to a feather bed. The wound had healed by the eighth day. These symptoms were followed by a painful attack of chronic phlebitis of the left leg and thigh, and the foot became large from œdema. This disease affected the saphena, major and minor, the femoral, and even the external iliac vein, and was, at its height, so severe, as to create some alarm in my mind as to my patient's recovery.

Chronic phlebitis.

I excoriated the surface with hot water over the track of the vessels, and rubbed in an ointment, composed of one drachm of unguentum hydrargyri, and twenty grains of extract of opium. He took internally two grains of calomel, and one-eighth of a grain of morphia. This I repeated each night, rolling the thigh in flannel.

This treatment proved successful, and at the expiration of a week he had lost all sense of tenderness over the veins, and the œdema subsided.

On the thirty-second day Mr. P. complained of pain in the left arm, and I observed the basilic vein to be the seat of the same disease as had attacked the veins of the leg. I treated it with the blue ointment and opium, and with the same success.

Sac reduced. In the mean time the sac became greatly reduced in size, and the hand had regained its sensibility and its temperature. The ligature continued firm; but though unwilling to employ any kind of force, I drew it obliquely in all directions, and wound it around a small roller of plaster. I felt satisfied that it was not detached from the old vessel, because it rose and fell with the first rib in every act of respiration.

Temperature restored.

I removed it on the forty-seventh day, without force, and without the escape of a drop of blood. The depth of the wound, as indicated by the length of the ligature, was one inch and an eighth. The pulsation in the radial artery returned on the fifty-first day. At the present date, which is nine years after the operation, Mr. P. has had no return of disease, and is in possession of good health.

Ligature separated on forty-seventh day.

Many forms of needle have been invented by surgeons, as well as by instrument makers, to obviate the occasional difficulty of passing the thread around the subclavian, and other arteries. That which I employed in the above case was a modification of the needle recommended by Mr. Alcock, in which the curved part is made spiral, not unlike the form of a portion of a corkscrew. *See* page 236.

It is of the utmost importance that the artery be clearly exposed to the view, not only of the operator, but of his assistants. Unfortunately the lowest branch of the axillary plexus, which lies in immediate contiguity with the artery, when it has passed the scalenus, has been mistaken for the vessel, on more than one occasion, and tied. In Mr. Liston's first case this accident had nearly occurred. The ligature was applied around what appeared to be the artery, but on pressing the object it did not control the pulsation in the sac. This led to further observation, which detected the error, and the ligature was removed. I have witnessed a similar occurrence.

Nerve liable to be mistaken for the artery.

In all such cases the operation has proved fatal.

## OPERATION FOR TYING THE AXILLARY ARTERY.

From the lower border of the first rib to the inferior margin of the tendon of the latissimus dorsi, the main arterial trunk of the upper extremity takes the name of

Relative anatomy.

*axillary*, from the cavity through which it passes. Its length is about five inches. In its upper half it lies deeply under cover of the pectoralis major and minor muscles. In its lower half it takes the direction of the humerus, lying along the outer side of the axillary cavity. On leaving the lower border of the first rib the artery is covered by the pectoralis major and an expanse of fascia, which descends transversely outwards from the first rib to the coracoid process, called the costo-coracoid ligament. The vessel here lies on the first digitation of the serratus magnus. Pursuing a course of about an inch and a half, it passes in an oblique direction underneath the pectoralis minor, within about one inch of its insertion into the coracoid process. The breadth of the muscle is, at this part, about an inch and a quarter. Leaving the pectoralis minor, the artery is again covered by the pectoralis major, and lies in the hollow of the axilla, across the apex of which it passes, while surrounded by the axillary plexus of nerves. Reaching the outer or humeral side of the axilla, it lies on the subscapularis muscle, by which it is separated from the head of the humerus. Descending, it is placed on the latissimus dorsi, to its termination in the brachial artery. In the upper half of its course it is only accessible to the surgeon by a division of the pectoralis major muscle; in the lower half it may be exposed in the axillary cavity.

Axillary vein.

Throughout its entire length the axillary vein lies anterior and internal to it, if exposed on the dead subject, but in the living body the veins are so greatly distended, and so irregular in their course and distribution, that a considerable portion of this vein will be placed partly in front of the artery. In the lower or axillary portion the artery is surrounded by veins of large size, the thoracic and subscapular, which cross it in various parts of its course.

Axillary nerves.

One or two thoracic nerves, from the upper part of the plexus, cross the axillary artery, in the first part of its course, immediately below the clavicle; and while in the axilla, the vessel is surrounded by the axillary plexus of nerves, at the lower part of which the median nerve lies nearly in front of it. This nerve is formed by two roots, the outer of which it receives in common with the external cutaneous nerve, while the inner is derived, in common with the ulnar and cutaneous, from a separate root of the axillary plexus. The depth of this artery below the skin in its upper half is about one inch and a half.

Next in liability to the poplitea, the axillary artery is the subject of aneurismal disease. The occult nature of the cause, and the general occurrence of aneurism of this vessel in the lower classes of society, will explain why such patients rarely resort to medical assistance before the disease has made considerable progress. Disease of the vessel is denoted by the usual symptoms affecting the circulation of the extremity. An aneurismal tumour forms, which interrupts the free current of the blood through the part of the vessel below it. Pulsation in the radial and ulnar arteries is indistinct, or at least is reduced in strength, when compared with that of the opposite limb.

Symptoms of aneurism of the artery.

The presence of the aneurism is denoted by a tumour of very uncertain dimensions, occupying any part of the length of the axillary trunk. If it commence in the first part of the vessel, the tumour will present itself behind the pectoralis major muscle, which is pushed forward in a diffused swelling, pulsating synchronously with the heart and general arterial system. This swelling will be very perceptible by examination in the axilla. On the other hand, the lower stage of the artery may be the seat of its disease, when the tumour will occupy the axillary cavity, and acquire a considerable magnitude before it has produced any material change in the form of the pectoral muscle. Under either of the above conditions, should the tumour become large, but more especially in disease in the first part of its course, the shoulder is forced upwards by the increasing swelling. It is by this elevation of the clavicle that the subclavian artery is rendered so difficult of exposure. The proximity of the artery to the plexus of nerves supplying the upper extremity causes numbness of the limb, by pressure on the plexus. In cases of advanced disease, it is important, in forming an opinion as to the locality of the origin and seat of the aneurism, to ascertain the date of the numbness, whether it was an early or a late attendant on the disease. If early, it is most probable that the lower part of the vessel was first involved, and more especially so, if a portion of the limb only became at first affected, such as the parts supplied by the median or ulnar nerve, to the exclusion of the remainder of the hand or arm.

If, on the other hand, the numbness followed at the expiration of some weeks from the first appearance of the disease, and the shoulder became elevated prior to the occurrence of numbness, and the pectoral muscle be elevated and prominent, then, in all probability, we shall correctly infer that the upper portion of the vessel is the seat of the aneurism. In this latter case, the altered relation of the clavicle is not the only consideration, for we must keep in mind the possibility of the disease having so far encroached on the subclavian artery itself, as to prepare us for the necessity of exposing the vessel behind the scalenus, or even on its inner side.

Objection to operation below the clavicle.

The axillary may be tied in any one of three parts of its course, either above the tendon of the pectoralis minor, below that tendon, or when lying in the lower part of the axilla, on the insertions of the subscapularis or latissimus dorsi muscles. In looking at the relations of the trunk of the subclavian, on the outer side of the scalenus muscle and the axillary artery, lying underneath the thick mass, comprising the subcutaneous fat and the pectoral muscles, there cannot be much hesitation in selecting the former as the seat of operation. Contrasting the superficial position and the freedom from complicated relations of the subclavian, with the depth of the axillary artery in this situation, shut out from judicious surgery, by an investment of a large and solid muscular mass, an extensive division of which is indispensable to its exposure, we can only refer its selection for operation in the cases in which it has been resorted to, to the uncertainty that prevailed at the date of these operations, as to an adequate supply of blood to the extremity. It is an operation greatly to be deprecated, and only justifiable in cases of wounds involving the axillary trunk, or its primary branches.

Operation for exposing the axillary artery.

The axillary artery may be exposed by an incision commenced about two inches from the sternum, and almost directly below the clavicle, and carried outwards, either in a line slightly arching downwards, or in a straight line obliquely outwards and downwards, to the extent of from four to five inches (*see* fig. 1). If carried too far, the cephalic vein, ascending between the pectoralis major and deltoid muscles, may be unnecessarily divided.

The line being clearly determined on, the patient should be placed nearly horizontally, with the affected arm extended for the purpose of rendering the pectoral muscle tense. The muscle should be divided nearly to the same extent as the external incision. The wound should be kept as free from blood as possible, either by active sponging, or by waiting for a few minutes, until the hæmorrhage has ceased spontaneously. The cellular tissue, or the fascia covering the artery, which is thickest in the first stage of the vessel, should be removed by a blunt silver knife, or torn asunder. The artery may then be readily exposed, either above or below the tendon of the pectoralis minor, on bringing the arm to the side, by which the fibres of the pectoralis major are relaxed.

The needle should be placed around the vessel from below upwards, in order to avoid the axillary vein. Of its branches, the thoracic axis, supplying the short thoracic, the acromial, and the humeral thoracic, is given off above the pectoralis minor, and the long thoracic, behind or immediately below that muscle. The artery being tied, the arm should be brought and fixed to the side, and the outer wounds united by suture.

Operation in the third stage.

For aneurismal disease of the brachial artery, the axillary trunk may be tied in the axilla, both with less difficulty, as well as less danger to the patient. For this purpose the trunk of the patient should be placed quite horizontally, with the head raised on a pillow. An incision, very oblique to the previously ascertained course of the vessel, should be made, to the extent of about two inches and a half, on the tendons of the subscapularis and latissimus dorsi muscles, in the fullest extension of the arm, which should also be rotated outwards as much as possible. This incision should involve the skin only, in consequence of the superficial position of the artery. It should be kept in mind that the artery is here surrounded with nerves, and that the axillary vein overlaps it on its inner side, or that next the chest, into which many secondary veins of considerable size may pour their contents. An assistant should hook up as much as possible of the anterior margin of the axilla. The sheath of the vessels and nerves being exposed, the scalpel should be laid aside, and a silver knife employed. The fore-arm should be bent for the purpose of relaxing the vessels. The nerves should be separated by the careful manipulation of the operator, who would endeavour to avoid exposing the artery when crossed by a large branch of a vein. It may be tied between the roots of the median nerve; but care should be taken not to include the nerves in the forceps, but to draw them aside with a blunt hook. The ligature should be passed around the artery, from within, outwards, the wound united by two sutures, and the arm extended on a pillow, when the patient is placed in bed.

## OPERATION FOR TYING THE BRACHIAL ARTERY.

Relative anatomy.

The main arterial trunk of the upper extremity receives the name of brachial, from the lower border of the latissimus dorsi muscle to the division of the vessel into its secondary branches, at the bend of the elbow. In the whole of this course, the artery lies so superficially that its pulsations may be felt on pressure. It pursues a straight course downwards, along the inner side of the biceps muscle, and inclining, at the lower third of the arm, to its front surface. It is placed respectively on the triceps, coraco-brachialis, and brachialis anticus muscles, being overlapped in the early part of its course, to the extent of about two or three inches of its length, by the coraco-brachialis, and then by the fleshy belly of the biceps muscle. As this muscle contracts in breadth on reaching the elbow, the artery inclines forwards upon the brachialis muscle. In the whole of the above course, the brachial artery is in close apposition with two or more veins, and with the median nerve, this close relationship being retained by a layer of tolerably dense fascia, derived from the biceps muscle, and from the cellular tissue condensed around. Two considerable branches, the superior and inferior profunda, are given off in the first two or three inches of the course of the vessel. The veins are usually three in number, two of which only are in immediate relation to the artery, and are derived from the

Venæ comites.

venæ comites of the fore-arm. All the arterial system of this region is provided with venæ comites, radial, ulnar, and inter-osseous, and even their secondary branches. At the bend of the elbow these numerous veins unite to form the two companion veins of the brachial artery, which proceed up the arm, having occasional branches of communication across the artery, either before or behind the vessel. Great irregularity prevails in their extent. Usually they are joined by the basilic vein, which lying upon the fascia of the fore-arm, becomes, like the venæ comites, a deep-seated vein on reaching the elbow. The basilic vein lies on the inner side of the brachial artery, at the bend of the elbow, generally at a distance of half an inch, and gradually approaches the artery in the upper part of the arm, where it is joined by one or by both the lesser veins, above described. The basilic or brachial vein here lies on the artery; occasionally the venæ comites unite immediately above the elbow into a single trunk, or one may join the basilic in the middle third of the arm.

Irregularity of venous distribution.

At the commencement of the brachial artery, the median nerve lies to the outer side, and a little in front of the artery, whence it pursues a straight line downwards, gradually crossing the artery to its inner side, where it is always situated at the bend of the elbow. Considering the breadth of the artery and the nerve, these two objects must always hold a relation of proximity in more than three-fourths of their course. The median nerve crosses over the artery, as a general rule, lying between it and the skin; in about one example in six, the nerve passes underneath the brachial artery. In the upper third, the internal cutaneous nerve lies to the inner side of the artery, and may be readily exposed in the operation for tying the vessel in this situation.

Median nerve.

Artery subject to irregular distribution.

Irregularities in the course of and division of the brachial artery are comparatively common; and before entering on the operation for tying this vessel, it is very desirable that a general survey of the arm be made, with a view to detect, if possible, the presence of any variety that may exist, or any departure from the general course and distribution of the vessel or its branches.

The chief irregularities to which the brachial artery or its branches are subject, are,—first, a common origin of the superior profunda with the posterior circumflex. It may be detected by its size, being less than one-third of that of the main trunk, and could never be mistaken by any surgeon, who is competent to attempt the operation for tying the brachial. Moreover, pressure on this lesser vessel would fail to arrest pulsation in the sac; and this fact, coupled with the internal position of the artery, would always raise the question of its identity. Second, a high division of the brachial into the radial and ulnar arteries; the two vessels being parallel, and in close apposition to each other. Either the radial or the ulnar may be given off from the main trunk of the brachial. Of these two varieties, the high origin of the radial is by far the most frequent. These two varieties are not identical. Under these circumstances, it descends along the arm, nearly in contact with the brachial, becomes superficial at the bend of the elbow, and descends immediately beneath the fascia to its destination in the hand. Other still rarer varieties occasionally present themselves to the anatomist.

Brachial artery rarely diseased.

True aneurism of the brachial artery is a very rare occurrence. In considering the size and importance of this vessel, it may be asserted with truth, that no artery in the whole system is less liable than the brachial to the occurrence of the kind of disease of which other arteries are the subject. Cases, however, are recorded. One example is related by M. Lisfranc of several aneurisms which occurred in the brachial artery of an individual.

Traumatic aneurism.

The brachial artery is usually tied for *traumatic* aneurism, caused by puncture during the operation of bleeding, by which the vein is transfixed, and the artery wounded by the point of the lancet. This occurrence is not an infrequent one in surgical practice. A healthy artery is wounded, and the blood escapes from the vessel in quantity proportioned to the size of the puncture, which being necessarily small, and the opening direct with the outer wound, the arterial blood mixes with that larger quantity flowing from the vein, and it is probably not observed by the inexperienced operator. Pressure is made on the wound common to the puncture in the two vessels, and with force proportioned to the difficulty in arresting the current. The oozing of the blood from the artery continues during the application of the pressure; on removing which, at the expiration of forty-eight hours or less, a small tumour may be observed to occupy the situation of the puncture, which pulsates synchronously with the arterial system.

The vein may lie in direct contact with the artery, or at some lines distant from it. The wound in the opposite wall of the vein may heal, or it may remain patent; and under this latter condition, the arterial blood will continue to enter the vein. I remember, some years since, to have seen a man, in whom the operation of venæsection had been performed with the above result. The aperture in the artery was considerable, but the outer wound healed. So considerable a quantity of arterial blood continued to escape from the artery, and flow into the vein, as to render the cutaneous venous system largely varicose. A thrill was observed, at the distance of many feet from the arm, which was considerably reduced in bulk, and its muscles equally so in strength and efficiency.

To these varieties of injury the inappropriate names of *aneurismal varix* and *varicose aneurism* have been applied, the former when the vein communicates directly, and the latter when indirectly with the artery. It must be obvious, that the term aneurism is inapplicable to this condition of the vascular system of the part, and that it can only be employed when qualified by the word *traumatic.*

Many weeks or months may elapse without any extension of the injury; or, as occasionally occurs, the blood may escape from the cavity by which it has been circumscribed, and become diffused throughout the cellular structure of the limb. In the year 1842, I tied the brachial artery which had been punctured in venæsection, in which the sac, as usually formed, gave way at the expiration of a fortnight, and the blood became largely diffused throughout the limb.

Composition of the sac.

As regards the material of which the sac is composed, it is probably the product of the common cellular tissue around the artery, although it has been a question much canvassed. Scarpa has referred it to the intermuscular ligamentous or fascial tissue, prolonged from the coracobrachialis muscle, and extending downwards to the internal condyle; but as this structure is found only on the inner side of the artery, and extends upwards for some inches in length, and as the tumour is mostly rounded in form, and is confined to the exact locality of the puncture into the artery, the explanation does not appear very satisfactory. That it is not formed by the fascial expansion of the tendon of the biceps must be equally obvious, from the fact that the wound in the artery is generally higher up the arm.

The comparatively small size which these traumatic aneurisms acquire after venæsection may be referred to the pressure of the pad and bandage, applied immediately on their occurrence, rather than to any peculiarity of local structure. The pressure is applied more positively than usual, consequent on the greater difficulty of arresting the bleeding.

Operation usually adopted.

The operation employed for the cure of this form of traumatic aneurism is an exception to a general rule, which prescribes a double ligature to be applied above and below any open wound through the coats of an artery from which the blood escapes. And the exception is, at first sight, a sound one, because, although in this example the blood does escape from the artery, yet it does not infiltrate the cellular membrane of the limb, but is as fully circumscribed by the sac as it would be by the dilated coats of the vessel itself in true dilatation ; and this fact brings it under the treatment due to circumscribed aneurisms in general. If there be any ascertained tendency in the sac to yield, then the double ligature must be resorted to, as the only safeguard against secondary hæmorrhage.

When it is ascertained that pressure on the brachial trunk commands the pulsations of the sac, that artery may be tied in any part of its course above the tumour, and is commonly tied for the cure of this injury ; but this fact is not very easily ascertained, consequent on the contiguity of the artery, be it radial or ulnar, to the main trunk, which the experience of the dissecting room exhibits as a frequent deviation from the regular distribution of the vessels of the upper arm. The pressure of the finger would probably, therefore, involve both vessels. This inquiry should be followed by a careful examination of the fore-arm, where the irregularity in the course of either radial or ulnar artery might be detected ; more especially that of the former, which frequently, under these circum-

Objections to the application of a single ligature.

stances, pursues a superficial relation to the muscles down the limb. No examination, however carefully made, can detect with certainty the variety that may really exist, and although a high division of the brachial artery into two vessels of very unequal size, or a high origin of the inferior profunda would, when exposed, rarely lead to failure in the hands of a careful operator, yet the means of judging by the exposure of these vessels infers a false step already taken. If to this evidence we add that of the occasional failure of the Hunterian operation in traumatic aneurism of the brachial artery, it may become a question whether the operation of opening the sac, and applying two ligatures around the artery is not, in the end, the more safe and the more perfect means of cure. The Hunterian operation for aneurism is resorted to in cases of traumatic puncture of the brachial artery, because it is deemed a simpler operation than that which has for its object the exposure by dissection through the sac of the punctured vessel; and it is fully justified by the circumscribing operation of the sac, which, whether formed by a true aneurismal process of dilating one or more of the coats of the vessel, or by a condensation of the cellular membrane around the artery, equally prevents an escape of the blood into the general cellular tissue of the limb, so long as it continues perfect.

Double ligature at the sac preferable.

But the results attending this operation are not so invariably successful as to justify its performance without careful examination and inquiry; and I doubt whether, under all circumstances, the exposure of the artery at the point of injury is not the preferable course for adoption, because the most certain in its result. The chief ground of preference to be given to the Hunterian operation of tying the brachial artery at any distance above the elbow-joint, is the greater simplicity of the undertaking. I am inclined to question the force of this argument. The brachial artery, notwithstanding its superficial position in the limb, is surrounded by important structures; and simple as the operation appears, I have never seen it completed in the hands of practised operators within a period of from a quarter of an hour to twenty minutes, or longer; and on one occasion, when performed by so experienced an operator as the late Baron Dupuytren, half an hour, no very unusual period for this operation,

The Hunterian operation not a certain cure.

Operation on the sac not more difficult.

was required. There cannot be a doubt, I imagine, the question of time and difficulty being laid aside, that a surgeon would feel better satisfied in having entirely cut off the disease by the application of the double ligature, than by having applied a single ligature to the artery for the treatment of a disease, the cure of which is yet to be completed; and I doubt whether, comparing the two operations together, that of exposing the wound in the vessel can be deemed the more difficult of the two, while it is undeniably more certain in its results. Having performed both on more than one occasion, I do not hesitate in giving the preference to the operation at the seat of injury.

Operation.

The arm should be widely extended from the body, and supported on a firm table, and should be held in rotation outwards as much as possible, without giving pain. The surgeon, if about to operate on the right arm, should stand at or below the elbow of the patient; if on the left arm, it will be more convenient in operating with the right hand, if he stand at his shoulder. The artery may be exposed in any part of its course with nearly equal facility; but it is desirable, when the operation is performed for the cure of traumatic aneurism, that it be exposed and tied at some little distance only above the injury; for however well established may be our convictions on the subject of inosculation, yet there is no advantage to be derived from cutting off the collateral channels of future supply; and we have here no disease of the arterial coats demanding distance between the ligature and the sac.

Commencement of inferior third.

Again, in the middle of the arm, the artery is often greatly overlapped by the biceps muscle, and is generally covered by the median nerve; therefore, we may select the upper part of the inferior third of the arm, as the most unobjectionable for the operation. An incision of about two inches in length, carried across the artery in *an oblique* direction, at about an angle of 35° or 40° with it, will expose the fascia covering the vessel (*see* fig. 1). Care should be taken to avoid the basilic vein, the course and situation of which should be previously noted if possible. The fascia may be rendered tense by the pressure of the fingers of an assistant on the biceps muscle, or by drawing the muscle outwards, taking care that he does not drag on the wound in the integuments.

The fascia may be divided on a director, or without one, to the extent of about an inch, when the pulsations of the artery will be distinctly felt by the finger. All that is now required is to separate the median nerve and the venæ comites from the artery, and this is effected more safely by means of a silver knife. The ligature may be carried round the vessel from within outwards, or *vice versa*; it is of little importance which, probably the greater magnitude of one of the venæ comites, and that more commonly the internal one, may determine the question, if any arise; a matter of choice which rarely merits the importance attached to it. If, in exposing the trunk of the artery, the origin of the anastomotic branch be brought into view, the ligature should be applied around the artery above its origin, and not below it.

Median nerve.

If the operation be performed in the middle of the arm, it will be recollected that the median nerve lies in this situation upon the artery. It should be drawn to either side with a blunt hook. More care in dissecting on the vessel will be required from the larger size of the venæ comites, which increase in magnitude as they ascend, by the junction of the muscular branches of the arm. In the upper third, attention should be paid to the origin of the inferior, and even to the possible exposure of the origin of the superior profunda. In this situation the median nerve would of course be drawn outwards. If in either of these operations a second artery of size were exposed, the relation of either one to the sac should be ascertained by pressure before passing the needle underneath it, and the other vessel be left untouched.

Operation at the sac.

In the operation for obliterating the brachial artery at the point of injury, at the bend of the elbow, the arm should be placed as in the former operations, and the fore-arm supinated; a tourniquet should be applied to the artery, in the middle of the upper arm, or the artery pressed by the fingers of an assistant. The course of the biceps tendon should be ascertained, and an incision, longitudinal in direction, should be made in the integuments over the sac, to the extent of about two inches and a half, or less. This incision will probably divide the vein, which was transfixed at the former operation.

This, however, is an evil of slight moment, if of any; for the vein will be more or less obliterated by the diseased actions which have been carried on underneath it. Of course it is not advisable to divide the vein, if it can be avoided without adding to the difficulty of the operation, by giving a false direction to the first incision. The sac should be opened with some care, and the blood contained within it, partly fluid and partly coagulated, should be removed by a small piece of soft sponge, or, if necessary, carefully scraped away, or separated with the handle of the scalpel. If requisite, the sac may now be yet more fully divided, and the finger applied to the bottom of the cavity, to ascertain the degree of proximity of the wounded vessel. Probably at this stage the wound may be brought into view, although the artery may require a little more dissection to expose it in length sufficient to enable the surgeon to apply a ligature both above and below the aperture, which will generally be found considerable in size, when compared to the wound originally made in its coats. It is better to introduce the aneurism needle a second time, and apply the ligature singly, than to pass a double thread around the artery and attempt to draw them asunder. In other words, the artery should be as little disturbed as possible in its relation to the surrounding parts. It is very desirable, in this operation, to avoid the fascial expansion of the biceps muscle. By its division in those cases especially in which the sac has partially burst, and the blood become diffused throughout the limb, the healing process is often protracted for many weeks, and contraction of the arm, by permanent flexion of the elbow-joint, has followed. Under all circumstances, this operation on the artery at the elbow-joint should be done carefully, and with as little violence to the exposed parts as possible.

Ligatures to be applied singly.

Avoid division of biceps fascia.

## OPERATIONS FOR TYING THE RADIAL AND ULNAR ARTERIES.

The radial artery pursues nearly a straight direction from its origin on the inner side of the tendon of the biceps muscle to the radial side of the fore-arm, where the pulse is usually felt. But this general knowledge would prove insufficient to the surgeon in cases of difficulty; we should know its relation to the muscles of the fore-arm. Throughout the whole of its course to the root of the thumb, the radial artery is uncovered by muscles crossing it, although it is partly overlapped by several. In supination of the hand, the radial artery crosses the tendon of the biceps muscle; in descending, it lies between the mass of muscle covering the head of the radius, of which the supinator longus is the most prominent, and the mesial or inner muscle, from the mass arising from the internal condyle, viz. the pronator teres. Passing downwards over the insertion of the pronator teres into the radius, it lies between the flexor carpi radialis and the long supinator, resting on the deep fibres of the flexor sublimis digitorum, and on the flexor pollicis. It is accompanied in the whole of its course by two venæ comites, and it holds the relation of near proximity, in the first two inches of its course, with the branches of the radial nerve. In the rest of its course the radial nerve is sufficiently to its outer side to render farther allusion to it unnecessary.

**Relative anatomy of radial.**

The ulnar artery commences from the same point as the radial, and is formed with it by the subdivision of the brachial. Its course is obliquely inwards. It occupies the upper half of the fore-arm in passing underneath the four superficial muscles, arising from the inner condyle, and about midway between the elbow and wrist joints, the ulnar artery lies, uncovered by muscle, on the flexor profundus, having emerged from the mass which has crossed it in its descent. In this situation the ulnar artery lies about three-quarters of an inch from the inner surface of the arm. In the last two or three inches of its course, and before passing over the annular ligament, it is overlapped by the tendon of the flexor carpi ulnaris. If the muscles of the fore-arm are unusually large, the

**Relative anatomy of ulnar.**

inner tendon of the flexor sublimis will be in so close contact with the flexor ulnaris, that the artery is covered to within four inches of the wrist. Both radial and ulnar arteries are covered by a dense fascia, produced from the deep-seated muscles and bones.

External line of the radial artery.

Ordinary aneurism of either of these vessels is almost unknown, but operations are not infrequently required for tying them in cases of wounds. The line of each vessel may be determined with sufficient precision to enable the operator, if not very familiar with the detail of their anatomy, to expose them without much difficulty. The radial artery may be exposed by an oblique external incision, the centre of which would cross any part of the line drawn from the middle of the arm at the elbow-joint to the line of the pulse, and the ulnar, by an oblique external incision across its course, indicated by a line drawn from the centre of the elbow, obliquely inwards, to half-way down the arm, the termination of its course inwards being one inch from the inner surface of the arm (*see* fig. 1). In the rest of its course, it passes longitudinally to the inner side of the os pisiforme.

Ulnar.

Division across the muscles.

Supposing the ulnar artery wounded in the upper part of the fore-arm, when covered by the thick fleshy mass of muscle from the inner condyle, the operation is a difficult one. I cannot subscribe to the opinion of Mr. Guthrie, advocated in his work on "Injuries of Arteries," who suggests the necessity of dividing the muscles across, avoiding the median nerve. If this dissection be indispensable, I should greatly prefer a longitudinal incision, through both integuments and muscles, till the artery be exposed underneath them. If the puncture were low down in the mass of flexors, it would be more prudent to separate the flexor sublimis from the flexor carpi ulnaris, as high as possible, by exposing the artery from below upwards; and but for the origin of the interosseous branch, I should prefer to tie the ulnar artery before it passes underneath the muscles, and again on its emergence from them, to a transverse section of the muscles themselves, as recommended even by the high authority of Mr. Guthrie.

Wounds of the palm.

For all wounds of the radial or ulnar arteries in the palm of the hand, the trunks of these two vessels should be tied above the wrist. When the superficial palmar arch is divided, the vessel retracts so much, and the structure of the palm is so elaborate and so important to the functions of the hand, that any attempt to seize the divided ends of the artery would be both futile and injurious.

I remember to have seen this attempt made by an experienced surgeon, who, after a lengthened effort, was compelled to desist and to tie the two vessels above the wrist. In all wounds of the larger arteries of the hand, both radial and ulnar artery must be tied, consequent on the frequent inosculations that exist between them. In wounds of the radial artery, after it has passed underneath the extensor tendons of the thumb, the recurrent flow of blood from the palm is nearly as large as the direct one, and the same remark will apply to wounds of the superficial or ulnar arch. In all such wounds, therefore, the two vessels should be secured. The radial artery may be exposed about two inches above the wrist, for the purpose of cutting off the direct supply to the superficialis volæ. The artery is readily exposed by means of an oblique incision across it, the fascia being then divided. A fine ligature may be passed behind it, including the venæ comites, if their separation from the artery be found difficult. The ulnar artery is exposed with a little more difficulty. The oblique incision being made at one inch distance above the wrist, the hand should be bent forwards, in order to relax the tendon of the flexor ulnaris, underneath which the artery will be found. During the dissection the hand may also be bent backwards, which, by rendering the flexor carpi ulnaris tense will push out the ulnar artery from behind it.

**Operation on radial.**

**Ulnar.**

**Tendon of flexor carpi ulnaris.**

The radial artery behind the thumb may be exposed by an incision across the proximal ends of the metacarpal bones of the thumb and forefinger, beginning close to the outer side of the tendon of the extensor secundi internodii pollicis, and for which the length of about one inch would suffice (*see* Fig. 2). It is necessary to keep this relation in view, or difficulty will be experienced in finding the vessel.

Such is the result of my own, and the yet more extended experience of my late friend and instructor, Mr. Abernethy. A dozen cases I have succeeded in at least. In one case only did some trickling of blood recur. In the hands of my late colleague, Mr. Vincent, this practice did not prove equally successful. His impression is, that a ligature on the radial and ulnar arteries will not suffice to arrest hæmorrhage in all cases. He recommends the application of firm pressure on the palm; and should this remedy fail, he would advise resort to a ligature around the brachial artery. In this view, also, I believe Mr. Liston concurred.

## OPERATION FOR TYING THE PRIMITIVE OR COMMON CAROTID.

Relative anatomy.

The common carotid emerges from the chest, behind the sterno-mastoid muscle, and proceeding upwards by the side of the trachea, it divides into its secondary branches opposite the upper border of the thyroid cartilage. In the early part of its course it is deeply placed, lying underneath the sterno-mastoid and sterno-hyoid and thyroid muscles. As it ascends, it becomes more superficial, covered only by the platysma and fascia of the neck. In the first part of the course the artery is unsupported; in the middle of the neck it lies on the rectus anticus and longus colli muscles, which separate it from the vertebral column. The right carotid, arising from the innominata, is somewhat larger than the left. It is also shorter, by reason of its origin from the innominata, and is placed a little anterior to the plane of that on the left side, in the lower part of its course. The left carotid, arising from the aorta, is of course longer, and it is not quite so close to the trachea in the early part of its course. An important difference of relation to the internal jugular vein on each side prevails, caused by the venous current being directed towards the right side of the heart; viz., that while the internal jugular of the right side, in its descent, diverges from the outer side of the artery, and leaves a space of more than half an inch between these vessels, that of the left side, slightly curving towards the mesial line of the neck, is placed considerably upon the carotid of its own side, rendering more difficult the attempt to expose the carotid on the left, than that on the right side at the lower part of the neck. At a distance of about two inches above the clavicle, the carotid artery is crossed

Different relations with veins on each side.

obliquely by the omo-hyoideus muscle passing upwards from its origin in the scapula to the os hyoides. In the lower part of its course, the common carotid holds important relations with the surrounding structures. It is connected by a dense sheath to the jugular vein; on the front lies the descendens noni nerve, for the supply of the muscles called the depressors of the os hyoides. The course of this nerve is oblique from without inwards. The inferior thyroid artery crosses behind the trunk of the carotid, and on the inner side ascends the recurrent laryngeal nerve. On the left side of the neck, the thoracic duct curves forwards from the inner side of the artery, to empty its contents into the subclavian vein. The pneumo-gastric nerve, and the trunk of the sympathetic, and many filaments proceeding from it to join the cardiac plexus, are found behind the carotid trunk.

**Relations with other structures.**

In the upper part or division of the carotid, the relations are more simple. The artery lies underneath the anterior margin of the sterno-mastoid muscle, having freed itself from the contact of the sterno-hyoid and thyroid. It here holds nearly the same relation to the vein on either side. It is covered by the edge of the mastoid muscle, and by the cervical fascia only, and its current of blood may be here arrested by pressure by the finger against the spinal column. In both of these two stages of the carotid, the artery is crossed by one or more veins of considerable size, proceeding outwards from the thyroid body. The lower branches often form a considerable plexus in front of the artery, where it emerges from the chest; the upper branches corresponding with the superior thyroid artery cross the trunk, above the omo-hyoid muscle, and empty themselves into the internal jugular vein. These veins may present a considerable obstacle to the easy passage of a ligature around the artery in either division of its course, if the sheath be unfortunately opened immediately in front of them.

**Thyroid veins.**

Aneurism of the common carotid artery is not a common disease, although it is frequently suspected to exist by hasty observers. The real disease presents a diffused tumour, occupying the middle of the lateral aspect of the neck, along the line of the artery, and pulsating synchronously with the arterial system. But this is not sufficient. The evidence of arterial disease must be most carefully examined. A tumour on the carotid trunk, occupying the middle of the neck, pulsating with the artery, will not prove to be aneurism in one example out of, perhaps, a dozen. It may be an enlarged gland or series of glands, or an encysted tumour, or enlargement of one lobe of the thyroid body, or the material of an abscess, or malignant growth, or any disease but an aneurism. If glandular, other glands may be felt about the neck, also enlarged; the tumour will be rounded, or, at least, circumscribed and firm. The mass is *jerked* by the action of the artery underneath it, not *expanded* by the increased quantity of blood forced into the cavity. The person may be strumous in character. The glands may have been more or less enlarged for a period far beyond that which developes aneurism.

Diseases simulating aneurism of carotid.

Strumous glands.

The late Mr. Burns, in his "Anatomy of the Head and Neck," recommends that the tumour be raised by the fingers, from off the artery, when the pulsation will cease. No doubt it will; but it is impossible to grasp any tumour of the neck beneath either the sterno-mastoid muscle or the cervical fascia. If an encysted tumour, it will also have existed for a far longer period; it will be circumscribed and soft. If an abscess, the period of its existence will prove, on inquiry, to be shorter in duration. It will be painful, more or less. It will not vary in form by reason of the pulsation of the carotid underneath it; and in this, as in the former case, we have the important negative evidence of the absence of the influence of the real disease on the branches of the carotid beyond it. The enlargement of one or other lobe of the thyroid body is a frequent occurrence, and is occasionally mistaken for aneurism. This enlargement may exist over the carotid artery. Its nature is softer and more elastic than that of ordinary tumours in this situation; it has a more marked pulsation than other tumours, consequent on its large supply of blood; and I have seen more than one example of this disease that had many of the external attributes of true carotid aneurism. On examination, however, the opposite lobe is found, though in a less degree, the seat of the same enlargement. The isthmus also will be found in some measure to participate in the altered structure. It will generally be observed

Chronic abscess.

Thyroid enlargement.

to exist in the young female. Its growth has been slow and uninterrupted; it is often more irksome than usual during the menstrual periods. It will also rise and fall with the larynx in the act of swallowing, proving its intimate relationship to the air-tube. Negatively, and often the most valuable evidence, it wants the peculiar expansion of aneurism, and the influence of a true aneurismal tumour on the branches of the artery above it.

Malignant growths.

Malignant diseases are so various in their form and origin that it is not surprising if we occasionlly meet with examples of such disease in the neighbourhood of the carotid artery that may be mistaken for aneurism of that vessel. A medical friend of mine, and an excellent surgeon, residing in the north of England, in the year 1848, wrote to me to the following effect:—"I am just sent for to ——, many miles distant, to examine and report on a case of carotid aneurism. I am aware how frequent is the appearance of this disease, and how rare is the reality; but, if it prove to be aneurism, I shall send the man up to you at St. Bartholomew's Hospital." On the day but one following, the man arrived. It was a malignant growth, and not aneurismal disease, and the man died.

Symptoms of carotid aneurism.

Carotid aneurism is ill-defined in form, firm in texture; it is not formed *upon* the artery, but enters into its structure; its pulsation is not conveyed to it, but is of it; it forms a part of the vessel itself; it has existed, perhaps, two or three months, and gradually enlarges, at an uniform rate of growth; increasing, however, as it advances; the pulsation in the branches beyond it, all partake of its influence, their calibre is reduced below that of the opposite side. The sense of local annoyance is permanent, not occasional, as in the hysteria attending thyroid enlargement. It is usually attended with pain and throbbing in the affected side of the head, hoarseness of voice, cough, and difficulty of breathing, caused by pressure of the tumour on the larynx or trachea. The local symptoms are increased when in the horizontal position. As has been remarked elsewhere, the real disease is rarely mistaken, diseases simulating it frequently.

Operation for tying carotid.

This operation was first performed by Mr. Abernethy in this country, and has been repeated successfully by many eminent surgeons in England and on the Continent. The carotid artery may be required to be tied, either in the upper or the lower part of its course; *i.e.* either above or below the omo-hyoideus muscle. If the aneurism be low in the neck, so near the chest as to render it probable that great difficulty will be experienced in passing a ligature around the artery, between its origin and the sac, which would be indicated by the presence of the tumour underneath the sternal origin of the mastoid muscle, Brasdor's operation, revived by Mr. Wardrop, should be resorted to, viz., that of tying the vessel on the distal side of the aneurism. For aneurisms of the carotid the lower part of the vessel is usually selected, the upper being tied for aneurism of its branches, hæmorrhage, or vascular tumours. Sabatier recommends, for the purpose of tying the carotid in the lower part of the neck, an incision corresponding with the interval between the sternal and clavicular origins of the sterno-mastoid muscle; but this incision is objectionable.

Brasdor's operation.

Line of incision in lower operation.

The head of the patient being placed nearly horizontally, but a little raised, and the face turned slightly round to the opposite side, an incision of about two inches and a half in length is to be carefully made through the skin, commencing at that distance above the sternum, upon the anterior edge of the mastoid muscle, and continued downwards, so as to pass on to the tendonous origin of that muscle from the sternum, about a quarter of an inch (*see* fig. 1). This incision will divide the integuments and some fascia, and some fibres of the platysma above. The anterior edge of the mastoid is then to be exposed, the muscle hooked up, and drawn outwards by a retractor; and for this purpose the patient's head should be brought round, and considerably raised on a pillow.

The sterno-hyoid and thyroid muscles, if the artery be required to be tied very low, should be drawn inwards, when separated with a blunt knife, and with them the filaments of the descendens noni nerve. The omo-hyoid may be exposed, when crossing the artery at the upper angle of the wound, or not.

The sheath of the vessels should be divided on a director to the extent of an inch, and the large veins from the thyroid body drawn asunder; the finger being applied to the bottom of the wound will readily detect the pulsations of the artery. Great care should be taken to avoid these veins, which often become largely distended with every act of expiration, and present great difficulties to the operator.

Jugular vein.

If the operation be performed on the right side of the neck, within an inch or more of the sternum, the internal jugular vein will be partially, if at all, exposed; if on the left, the jugular vein will be found lying upon, and almost covering the artery on its outer side, and should be very carefully drawn outwards. The carotid should be now partly insulated by dissecting around it, and the needle passed underneath it from without inwards, great care being taken that nothing but the artery be included; for it should always be kept in mind that on the left side, the thoracic duct, in addition to the inferior thyroid artery, and many nervous branches common to the two sides, lie nearly in contact with it.

Upper operation.

For the purpose of tying the carotid artery in the upper part of its course, an incision two inches, or two and a half, should be made along the anterior margin of the mastoid muscle, beginning on a level with the upper border of the thyroid cartilage. This incision will divide the skin, platysma, and general fascia of the neck.

The mastoid muscle being exposed, the head should be raised as in the former operation; and the muscle thus relaxed should be drawn outwards by a blunt and broad hook or retractor.

When the sheath is exposed to view, the descendens noni nerve will be seen descending along it; this nerve should now be drawn outwards, and the superior thyroideal veins be carefully hooked, either upwards or downwards, according to the convenience of the operator. The finger should be repeatedly applied to the artery, in order to ensure its being exposed towards the middle of its front surface. When the sheath is divided, and the artery cleared of its cellular structure, both in front and at each side, for a few lines in length, opposite the part at which the ligature is to be applied, the needle may be passed around it from without inward, or, if more convenient, in the opposite direction; great care being taken not to include the pneumo-gastric nerve, by keeping the point of the needle as close as possible to the posterior surface of the artery. It is very important that as little violence as possible be done to the parts involved in this disease. The formation of abscess has led to a fatal result, in many cases of great early promise. The thread being tied, the divided parts should be replaced as much as possible in their natural relations.*

## OPERATION FOR TYING THE SUPERIOR THYROID ARTERY.

This artery is occasionally tied in the treatment of bronchocele. The degree of difficulty of the undertaking depends greatly on the form of the enlargement of the thyroid body. The thyroid artery may be readily exposed in the neck of an ordinary person, and not less so, occasionally, when the thyroid body is enlarged. If in such cases the enlargement involve the entire body of the lateral lobe, then the vessel which is distributed to the anterior surface of the organ is pressed forwards underneath the skin, and its pulsations become apparent to the eye. In other examples, however, the growth of the thyroid body is lobulated and irregular, and composed of watery cysts; and then the lateral lobe overlaps the artery supplying it, and presses it inwards from the skin towards its under surface. Under these circumstances the attempt to tie the superior thyroid artery would be attended with difficulty, and some danger. In two cases in which this operation was performed by Mr. Earle, in St. Bartholomew's Hospital, the artery was large and prominent, and the operation was easy. Sir W. Blizard tied the superior thyroid in a case of bronchocele with some success, as regards its influence on the disease, although the patient died; her death being referable to remote causes. In Mr. Earle's cases, the operation also tended to check very considerably the growth of the tumours.

Exposure of artery often difficult.

Successful operation.

The patient's head should be placed nearly horizontally, and the neck elongated; and the course of the artery being marked out by a line drawn downwards and inwards, from a level of half an inch above and behind the upper border of the thyroid cartilage, an incision of from an inch to fifteen lines in length should be made across it, opposite the lower edge of the cartilage. The skin and platysma being divided, the cervical fascia should be opened, the mastoid muscle drawn outwards with a blunt hook, and the remaining parts separated with a silver knife : at the bottom of this wound the artery will be found. If the growth of the thyroid lobe be such as to press the artery forward, it will be rendered so superficial as to render any further detail unnecessary.

---

* In tying an artery the less that is seen of the surrounding structures, the better the operation. This remark applies to all cases. It was strikingly illustrated in an operation recently performed by Mr. Bowman, at King's College Hospital, which I witnessed. He tied the common carotid artery in a most masterly manner, and in the course of some excellent observations he subsequently made, he remarked that, in the operation, he saw nothing of those structures which lay around and in contact with the artery.

## OPERATION FOR TYING THE LINGUAL ARTERY.

The lingual artery is occasionally tied in cases of hæmorrhage from the tongue, the inosculating branches between the two vessels being inconsiderable. When the lingual artery arises low down from the external carotid, it curves upwards and forwards around and nearly in contact with the tubercle, forming the extremity of the great cornu of the os hyoides. When it arises half an inch higher this curve is not made, but under all circumstances it lies on the constrictor medius of the pharynx and *crosses the superior laryngeal nerve.*

**Relation of artery to os hyoides.**

The head of the patient being placed horizontally, and the neck lengthened by raising the chin, an incision of about twelve lines in length should be made immediately behind the corner of this bone, the outline of which should be distinctly ascertained before proceeding to the operation: the incision should be directed downwards and forwards. The skin and platysma being divided, the fascia is exposed, which should be also divided to the length of the external wound. The facial vein, often of considerable size, may be brought into view at the upper part of the wound, in its course downwards to the internal jugular, and should be drawn outwards. The remaining parts should be torn, rather than cut asunder, passing transversely inwards, nearly parallel to the upper edge of the cornu of the os hyoides, when the artery will be exposed. In passing the needle behind it, care must be taken to avoid the superior laryngeal nerve, which descends nearly at right angles behind the artery.

**Superior laryngeal nerve.**

## OPERATIONS FOR TYING THE FACIAL ARTERY.

Operation below the base of jaw.

The facial artery may be tied in the neck, or on the lower jaw. The origin of this artery is usually at a distance of about a quarter of an inch above that of the lingual. Taking the tubercle of the os hyoides as the guide, the external incision should be commenced in the skin, about half an inch higher than in the preceding operation. The artery will thus be exposed before it passes underneath the digastricus and stylo-hyoid muscles, or dips into the substance of the submaxillary gland. The facial artery is here crossed by the hypoglossal nerve.

On base of jaw.

On the inferior maxillary bone the facial artery may be readily exposed by an oblique incision upon the bone, immediately in front of the anterior border of the masseter muscle, and this margin may be as readily detected, by desiring the patient to close his jaws by compression of the molar teeth against each other. The oblique incision in this situation not only ensures the readily finding the artery, but it divides fewer filaments of the facial nerve. The facial vein lies on its outer side, between the artery and the masseter muscle.

## OPERATION FOR TYING THE OCCIPITAL ARTERY.

Relative anatomy.

Leaving the trunk of the external carotid, the occipital artery passes backwards, through a kind of loop of the hypoglossal nerve, and becoming nearly horizontal, it lies in a groove in the temporal bone, underneath the mastoid process, and beneath the muscles attached to it and to the oblique ridge extending backwards on the occipital bone, viz., the sterno-mastoid, the splenius capitis, and occasionally only underneath the trachelo-mastoid muscle, at the back of which it emerges, lying on the occipital bone. It is here placed at a distance of about an inch and a half behind the external ear, covered only by the dense tissue of the scalp, and is accompanied by one or more veins. The distance, however, of the artery behind the external ear will depend on the breadth of the insertion of the mastoid muscles, and this extent varies in different persons. It would be well to vary the distance from an inch and a quarter to an inch and a half, according to the general muscularity of the individual. The occipital artery may be exposed by an incision of about an inch in length, carried obliquely downwards and backwards across its course.

## OPERATION FOR TYING THE TEMPORAL ARTERY.

Proximity of nerve.

The course of the temporal artery can be traced by the finger passing upwards immediately in front of the cartilaginous structure of the external ear, and over the root of the zygoma. In this situation, the artery should be clearly exposed before the ligature be passed around it, lest the auriculo-temporal nerve or a filament of the portio dura be included within it; an incision of about nine lines in length should be made obliquely across the artery in either direction. The instruments employed should be fine, and the operation delicately performed, for the reason above stated. The artery and the artery alone should be included in the ligature.

Case.

A case of some interest involving this vessel occurred to me in 1847, in the person of a young lady. A small swelling formed upon the temporal artery, which appeared to me to exhibit the characters of aneurism. She was not conscious of having sustained any injury to the vessel by blow or otherwise. The pulsation was manifest to herself, and as the tumour increased in size, its pressure on the meatus auditorius became a source of great discomfort, particularly when she attempted to lay that side of her head on the pillow. Sir B. Brodie saw her, but doubted the aneurismal character of the disease. Some months elapsed, and she saw Mr. Liston, in conjunction with Sir B. Brodie and myself. It was then deemed aneurismal, and I tied the artery below the tumour. For some days the tumour, which had reached the size of a large bullet, diminished in size, and after remaining for some weeks stationary, it again began to increase. I had no doubt of its aneurismal nature, even at that time, but I considered it an erectile tumour communicating with the trunk of the vessel, because pressure on the artery below invariably reduced it greatly in size. Mr. Aston Key then saw it, and immediately pronounced it aneurismal. Its peculiar nature precluding any further operation upon it, I had a fine spring compress made by Ferguson, with a ball-and-socket joint, which passed over the head, and made permanent pressure on the tumour. The instrument was entirely concealed by her hair. My patient wore this instrument for fifteen months, at the expiration of which, the tumour had become solid, and all pulsation had permanently ceased.

## OPERATION FOR TYING THE ABDOMINAL AORTA.

Relative anatomy.

Descending from between the crura of the diaphragm, the aorta lies a little to the left side of the centre of the vertebral column, having the vena cava inferior on its right, and nearly in contact with it. Its division into the two common iliacs, takes place on the body of the fourth lumbar vertebra, just below the level of the umbilicus. The inferior mesenteric is given off from the aortic trunk, on the left side of the middle of the vessel, about two inches above its bifurcation. Two lumbar arteries arise from it, within half an inch of its bifurcation. The left lumbar veins pass behind it. The trunks of the two sympathetic nerves lie on the bodies of the vertebræ, a few lines only from the surface of the vessel. The abdominal cavity is lined by the peritoneum, which is placed posteriorly in close apposition with a loose fascia covering the aorta. In order to expose the vessel from the front of the abdomen, two layers of this membrane must necessarily be divided, and the intestines pushed aside. The depth from the abdominal parietes, through which the first incision is made to the aorta, across a cavity already occupied by intestine, must in some subjects be very great.

Operation.

Sir A. Cooper's

This operation was first performed by Sir Astley Cooper, in the year 1817, for an aneurism of the external iliac artery that had sloughed. He made an incision, three inches in length, along the line of the linea alba, curving the line to avoid the umbilicus: having opened the cavity of the abdomen he pushed aside the intestines, tore through the peritoneum covering the artery, with his finger-nail, and passed an armed needle around it, at a distance of three quarters of an inch above the bifurcation. The patient survived the operation two days.

and Mr. James's case.

The aorta was also tied by Mr. James of Exeter, in the year 1829, for aneurism of the external iliac artery, for which, a month prior, he had performed the operation of Brasdor, by tying that vessel on the distal side of the aneurism. The operation of Mr. James corresponded with that of Sir A. Cooper. The patient survived some hours only.

Danger of exposing cavities.

The question as to the feasibility of tying the aorta on the living subject, without the immediate destruction of life, may be said to have obtained conclusive evidence in its favour by these two operations, and more especially by that of Sir A. Cooper. It is a matter of history, that nearly all the early operations on large vessels have proved fatal, and that complete success has finally crowned the repetition of the attempt. The success of Sir A. Cooper's operation on the aorta, was sufficient to justify its repetition in a case of equal emergency; and it would be the equally justifiable resort of the surgeon on such conditions, even were it certain that four out of five operations must prove necessarily fatal, for death is certain without it. It may be doubted, however, whether the kind of operation practised in the above cases was that most likely to ensure a favourable result. The exposure of the cavity of the abdomen, the violence done to the healthy peritoneum, and the handling and concussion of the intestines, are very probable elements of future evil. Nature is very jealous of any degree of exposition of the cavities of the body; and when we add to the evil of this violence, that also done to the largest vessel of the arterial system, we shall not be surprised at the result. One half of this difficulty may be averted by another operation, viz., that of tying the aorta behind the peritoneal cavity, by an incision which would admit of the peritoneum being raised with the mass of intestines, without being opened. Should opportunity, unfortunately for the individual, occur, we can see no reasonable ground why success should not become at least its occasional, if not its frequent attendant, such is the admirable machinery of the arterial system. The nature of this operation will be described in that of the operation for tying the common iliac artery, and to which the reader is referred.

## OPERATION FOR TYING THE COMMON ILIAC ARTERY.

Relative anatomy.

At the lower border of the fourth lumbar vertebra, the aorta divides into the two common iliac arteries, which, diverging from each other, and from the mesial line, pursue a course of about two inches, lying on the inner side of each psoas magnus, where they subdivide into their secondary branches. The course of these two vessels in the subject is indicated by a line drawn from the centre of the abdomen, half an inch below the umbilicus, to a point in Poupart's ligament, midway between the anterior superior spine of the ilium and the symphysis pubis. This line follows the course of both the common and external iliac arteries, with sufficient precision for all useful purposes. A great variety occasionally prevails in the length of the common iliac artery, and consequently on that of the two consecutive branches into which it divides. This vessel, of an average length of about two inches, is often found to exceed that length by one or even two inches, under which circumstances the external and internal iliac are reduced in the same degree in their average dimensions. Occasionally the division into these secondary branches takes place at the termination of one inch or more of its course. These peculiarities should be kept in mind by the surgeon while operating on either of these three vessels. The right common iliac artery crosses the right common iliac vein, the left artery having its corresponding vein on its inner or mesial side. Each common iliac artery is crossed obliquely by the ureter of its own side; but the connection of the ureter to the peritoneum is somewhat stronger than that to the artery, for in raising this membrane the ureter usually follows it. The peritoneum is applied loosely upon the iliac arteries, and is raised from them without difficulty. The distance of the arteries from the front of the abdomen will vary of course, according to the degree of obesity of the person under inquiry, and to the condition of repletion of the intestines.

Variety in length.

Iliac vein and ureter.

Symptoms requiring it.

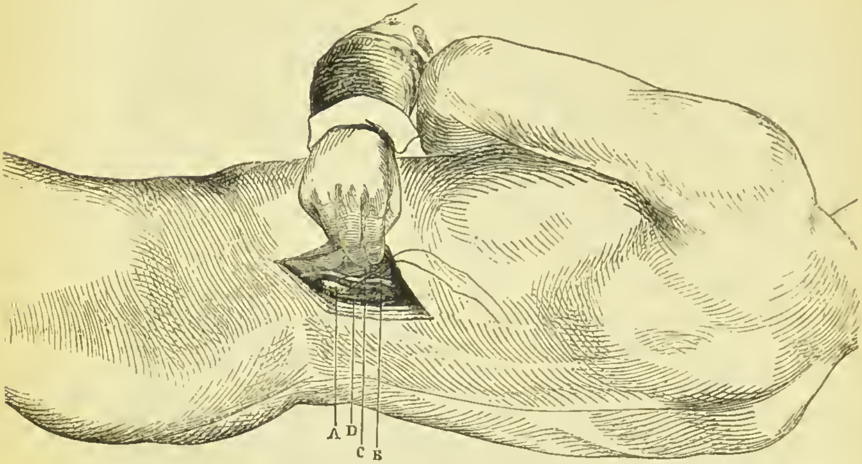
In a case of aneurism of the external iliac, which is obviously seated high up in the artery, conveying a considerable pulsation to the parts around, and forming a tumour in the lateral part of the abdomen, some inches in extent, above Poupart's ligament, perceptible through the abdominal walls, and more especially if the tumour be so placed as to raise the question of its probable seat in the internal iliac, it would become necessary to apply a ligature around the common iliac, and this operation, formerly deemed impracticable, with any probability of success, has been performed on several occasions.

The common iliac artery was first tied in New York, by Dr. Mott, for aneurism of the external iliac, in the year 1827, and in 1828, by Sir P. Crampton, in Dublin, for the cure of the same disease. Dr. Mott's case recovered.

The operation performed by Dr. Mott was founded on that adopted by Mr. Abernethy, for tying the external iliac artery, and consisted of an incision made through the parietes of the abdomen over the vessel. That of Sir Philip Crampton, although in that individual case unsuccessful, was a great improvement on its predecessor. A repetition of this operation was performed in St. Bartholomew's Hospital, in the year 1846, by Mr. Stanley, for the cure of a disease of the left ilium, and as it appeared to me that the object was attained in his hands with remarkable facility, I cannot do better than record my recollection of its details.

Operation.

The patient, a middle-aged man, was placed on the operating table, with his body inclined over to the right or sound side, the shoulders and trunk were bent a little forwards, for the purpose of rendering the lumbar integument tense. The line of the last false rib being ascertained, an incision was made from its cartilage or nearly its point, in a line downwards, and somewhat forwards, to the crista ilii. This incision was about three to four inches in length. The division of the integument was followed by that of the external oblique, internal oblique, and transversalis muscles, singly and successively. The external incision was then elongated along the line of the crista ilii, to the extent of about three inches more, and the division of the three muscles from the bone completed; comparatively little blood escaped. Reverting to the situation of the first incision, Mr. Stanley then divided the fascia which lines the inner border of the muscles in this situation, and extended the division of the fascia to the entire limit of the external wound. He then raised the mass of intestine enveloped in the peritoneum, and pushed it inwards, bringing into view



A. Artery. B. Ureter. C. Peritoneum. D. Psoas magnus muscle.

the psoas magnus, left ureter, and, finally, the common iliac artery, around which he passed a ligature, without any apparent difficulty.

**Preferable to the anterior operation.**

I consider the advantages of this, over the anterior operation to be very striking, first, inasmuch as the abdominal parietes must be divided, it is a less objectionable region in which to divide them, because less sensitive, and less liable to consequent inflammation. Secondly, the requisite separation of the peritoneum from its relations to the abdominal walls, is less extensive, and consequently we have less liability to suppurative action. In the anterior operation the detachment of the membrane from the walls of the abdomen is much more extensive. Thirdly, in the posterior operation the artery is brought fairly into view, and the act of passing the needle around it is made visible to observers around. The external incision in the case of Dr. Mott was eight inches in length ! and must have extended from Poupart's ligament nearly to the umbilicus. Fourthly, by tying the common iliac artery by means of the posterior operation, the line of the vessel is sufficiently exposed, to enable the operator to select his point of contact for the ligature, to carry it either higher or lower, or even, if necessary, to separate the peritoneum from the aorta itself, and to pass a ligature around that vessel, at a sufficient distance above its bifurcation; and, fifthly, should the patient recover, the formation of ventral hernia, consequent on the imperfect union of the muscular parietes, is less likely to occur than in the anterior operation. It is no evidence unfavourable to this plan of operation, that both the case of Sir P. Crampton and Mr. Stanley failed, any more than it is favourable evidence to the anterior operation that the case of Dr. Mott recovered. It is only by frequent repetition that the respective merits of the two operations can be practically ascertained, and I have no hesitation in expressing my preference for the English operation.

## OPERATION FOR TYING THE INTERNAL ILIAC ARTERY.

Relative anatomy.

The internal iliac artery descends from the point of bifurcation of the external iliac along the walls of the pelvis. It diverges from the external iliac, at an angle of about 25°, and proceeds forwards to the extent of about an inch before it yields any branches, of which the first is the ilio-lumbar. The right artery lies in front of the corresponding vein, but the left crosses in front of the left *external* iliac vein, having, on the right side, the left internal vein immediately behind it. But many, yet large though lesser veins congregate around and empty themselves into it in this situation. The ureter on each side is placed internal, and a little posterior to it. Both arteries and veins are invested by a layer of the pelvic fascia, upon which is placed the peritoneum. If a line be drawn from the mesial line of the abdomen, half an inch below the umbilicus to Poupart's ligament, midway between the anterior superior spine of the ilium, and the symphysis pubis, and the two upper inches of such a line be allowed for the common iliac artery, a second line, drawn downwards from this point, at an angle of about 25° with the first, nearly parallel to its fellow of the opposite side, will indicate, with tolerable exactness, the course and direction of the internal iliac artery, with respect to the anterior wall of the abdomen.

Difficulty of diagnosis.

The internal iliac is the subject of operation in cases of aneurism of the gluteal or other of its branches. Its situation and relations in the pelvis would hopelessly preclude its certain diagnosis, if diseased; for the only accessible direction by which its symptoms could be manifested, would be that directly forwards, in which case the disease would be, in all probability, referred to the external iliac. It has usually been tied for aneurism of the gluteal artery, and it would be equally compulsory in a similar affection of the ischiatic or pudendal, or, indeed, in any one of the primary branches, could the existence of such disease be ascertained with certainty.

Operation.

This operation was first performed in the year 1812, by Mr. Stevens, of Vera Cruz, on a slave woman, for gluteal aneurism :* the woman recovered; and a second time by Mr. Atkinson, of York, whose patient died on the nineteenth day.

Line of incision.

The process of exposure of the artery, adopted by Mr. Stevens, consisted in an incision made through the anterior abdominal parietes. This incision was five inches in length, and was situated "at the lower and lateral part of the abdomen, parallel to, and about half an inch on the outer side of the epigastric artery." This process is yet practised in the operation in question, and is probably the most eligible that can be adopted.

Objections to posterior operation.

The posterior operation labours under considerable disadvantages, in reference to the internal iliac, which are not referable to the common iliac. By the posterior incision the internal iliac is concealed behind the bone, the cavity of the pelvis is not exposed to view, the internal lies behind the external iliac, and being surrounded by numerous and large veins, any wound of which would probably prove fatal, such an operation is, I conceive, objectionable. Although I believe the finger could be placed in contact with the artery more readily in the posterior, than in the anterior operation, yet the eye could not so readily reach it; and this circumstance is fatal to a safe proceeding, and the difficulty of the posterior operation would be materially increased, if, during its performance, it appeared that the common iliac were of unusual length. In that case there would remain no other alternative but that of tying that vessel. We must, therefore, resort to the anterior operation, and for this purpose an incision should be made over the line of the artery, the direction of which will be ascertained with care and precision. The external iliac artery passes under Poupart's ligament, midway between the anterior superior spine of the ilium, and the symphysis pubis; from this point, the course of the trunk is indicated, as above stated, by a line drawn upwards and inwards to meet its fellow half an inch below the umbilicus. The upper two inches of this line will correspond with the common iliac, and from this point the two iliac arteries diverge from each other, the internal descending forwards at an angle of about 25° or 30° with the other branch.

---

* Medico-Chir. Trans., vol. v.

Relation of artery to the external wall.

This point of subdivision between the two iliac arteries is about the distance of from four to five inches above Poupart's ligament, and about four inches from the crista ilii, opposite which it lies. If we take half an inch internal to this line for the internal iliac, we shall hit the exact line of the vessel. It is unnecessary to make this incision of immoderate dimensions. Probably from four to five inches will suffice for all the manipulation required, and every half inch of incision saved to the patient, not only promises a more favourable immediate result, but renders the occurrence of ventral hernia less probable. The incision should be commenced at a point about one inch above Poupart's ligament, and continued upwards and inwards, over the line of the *external* iliac artery, or along this line from above downwards. Such an incision will permit of the integuments and muscles being sufficiently drawn inwards, to enable the operator to expose the artery to his ready view. Some additional care is requisite in dividing the fibres of the transversalis muscle, lest the transversalis fascia, which lines its under surface, be wounded unintentionally and the peritoneum be injured.

Careful division of transversalis.

When the transversalis muscle is fully divided to the extent of the division in the outer skin, the fascia transversalis should be equally divided, by means of a director passed underneath it. The hand then passed into the wound should carefully separate the peritoneum from the iliac fossa with the mass of intestines. This is now the only obstacle to the exposure of the artery; but great gentleness and a light hand are requisite for this purpose. The iliacus internus and the psoas magnus will be thus brought successively into view; and on the middle of the latter muscle will be felt the pulsations of the external iliac; and still more internally, and within the cavity of the pelvis, *i. e.*, about one inch lower, will be felt those of the internal iliac artery. The vessel should be exposed to the sight and examined, more especially in the act of passing the ligature, lest injury be done to the veins which ramify about it. The needle will be most readily introduced on the outer side of the vessel; the cellular connections of which should be carefully separated by a blunt or silver knife, before attempting to pass the needle around it.

Manipulation.

## OPERATION FOR TYING THE EXTERNAL ILIAC ARTERY.

Relative anatomy.

The external iliac artery, commencing at the bifurcation of the common iliac trunk, is situated at its origin from that vessel, on the inner side of the psoas magnus muscle; and, at its termination, underneath Poupart's ligament, it lies on the anterior surface of the muscle. The artery generally presents a curve, the convexity of which is downwards, towards the pelvis, which is marked more positively in the female than in the male subject. Sometimes the curve is very considerable. In this course of from four to five inches, it arches forwards and outwards, to reach the front surface of the psoas, which is external to it, lying, however, somewhat nearer to its inner than to its outer side.

Here, again, I must remind the reader of the uncertain length of the external iliac artery. It is obvious, from this description and from the recollection that the curve of the crista ilii bends round towards it, in its descent, to reach the anterior superior spine of the ilium, that, as the artery reaches Poupart's ligament it gradually approaches the front of the abdomen, and also approaches the side of the body.

Relation to iliac veins.

The right external iliac vein passes underneath the corresponding artery, (the vena cava inferior being on the right side of the aorta,) and underneath Poupart's ligament, it lies to its left, or inner side; while, on the left side of the body, the external iliac vein having crossed underneath the internal iliac artery, descends along the right or inner side of its corresponding artery. In other words, the vein lies internally to the artery on both sides. The external iliac artery is accompanied by a fine branch of the lumbar plexus, the genito-crural, which lies either on its anterior or on its inner surface; the plexus itself being separated from it by the psoas muscle, in the substance of which it is imbedded. Although these vessels lie upon the fascia iliaca, they receive an investment of that fascia, which covers them in the whole of their course. The peritoneum, which invests the abdominal contents, is reflected laterally from the anterior walls of the cavity, into the iliac fossa; and again, backwards, over the vessels, to which it is attached by a very loose cellular tissue. Just before its passage underneath Poupart's ligament, the artery is crossed by the vas deferens. The external iliac furnishes two branches only, the circumflexa ilii, and the epigastric; the origins of which vary from three to eight lines above Poupart's ligament. It is also surrounded, in common with the vein, with a numerous and irregular chain of absorbents. In a case in which Mr. James tied the external iliac artery, a double vessel was found on examination after death. I have never met with a parallel example.

Genito-crural nerve.

The external iliac artery was first tied by Mr. Abernethy, in the year 1796. The patient had undergone Hunter's operation for a popliteal aneurism. A second aneurism formed in the opposite femoral, for which Mr. Abernethy tied that artery below Poupart's ligament. Hæmorrhage occurred on the fifteenth day, for which he tied the external iliac, within the cavity of the abdomen. The patient died. Mr. Freer, of Birmingham, repeated this operation, in 1806, with success. In the same year, Mr. Abernethy performed his third operation on this artery, and also with success. It has been since undertaken by most of the leading surgeons of England, and by many in France, with such results, as to justify the resort to it in all cases in which the arterial trunk of the lower extremity is diseased so close to Poupart's ligament, as to preclude the possibility of passing a ligature around the artery below it.

First tied by Mr. Abernethy.

The line of artery should be clearly defined according to the rules above indicated, and the patient laid quite horizontally on the table. The full extent of the tumour should be ascertained by careful examination through the parietes of the abdomen, and whether it extend very high upon the artery or not, this inquiry will furnish important results to the surgeon.

General remarks on the operation.

If the diseased condition of the artery be manifested by large pulsation, to the extent of three or four inches above Poupart's ligament, the only safe alternative will consist in tying the common iliac trunk. It is no argument against this necessity, that the external iliac artery is rarely if ever diseased to such an extent, because we have no reason to suppose the upper or middle part of this vessel to be free from the liability to aneurismal disease, of which possibly any day may furnish an example. The proceeding adopted by the operator will entirely depend on the extent of the tumour above Poupart's ligament. Of course, some degree of doubt may prevail in a fat subject, whose prominent abdomen and distended intestine may preclude the possibility of a very satisfactory inquiry; but, as a general rule, the pulsations of the tumour will be sufficiently distinct to permit a sound conclusion to be drawn on this subject.

Form of operation dependent on disease.

If the tumour extend to a distance of two inches or more above Poupart's ligament, it is obvious that that form of operation should be selected which will efficiently expose the artery above it. If the disease be confined to the femoral, at, or immediately below Poupart's ligament, the exposure of the vessel even at the lowest part of its course, *i. e.*, immediately above the ligament, will suffice. It is one important element in the successful result of an operation on the external iliac artery, that the contents of the abdomen be as little disturbed as possible; and therefore, in the abstract, that operation should be always preferred which will least conduce to this evil. The operation of Mr. Abernethy, in 1796, laid the artery bare in the direction of its course to the extent of about three inches, by a longitudinal incision. That of Mr. Freer, since modified by Sir A. Cooper, exposed the vessel by an incision more approaching to a transverse direction.

Relative merits of the two operations.

The latter is the simpler operation, and less liable to subsequent evil. But the first consideration is due to the necessity of the disease, and according to the evidence of the aneurism, involving the artery high up in its course, say to one inch or more above Poupart's ligament, is the operation of Mr. Abernethy, or that of Mr. Freer modified by Sir Astley Cooper, to be preferred. The merit of Mr. Abernethy's operation consists in the extent of the exposure of the artery to a distance above Poupart's ligament, and by which the occasional uncertainty of diagnosis is most effectually met. That of Mr. Freer has the advantage of greater simplicity, and in cases of disease confined to the femoral artery, is certainly more eligible, inasmuch as the artery is exposed in a nearly transverse direction, close to Poupart's ligament, with far less displacement of the peritoneum than is required in the former case. The objections to either one of these plans for operation in any given case, are founded on the merits of the other: that in Mr. Abernethy's longitudinal incision is attended by the necessary evil of extensive separation of the peritoneum from the walls of the abdomen; the greater difficulty of bringing the artery fully into view; the almost certainty of including in the ligature the genito-crural nerve; and the greater liability to the occurrence of ventral hernia, on the healing of the external wound; that of Sir A. Cooper being totally inapplicable to disease of the artery that is not confined to the vessel below Poupart's ligament, or immediately underneath it. If, on the completion of the transverse operation, disease be found to have extended higher along the artery, than a careful inquiry had previously ascertained, little advantage would accrue from its performance, and the longitudinal incision, recommended by Mr. Abernethy, must be resorted to, with a view to expose the artery beyond it. If, on the exposure of the vessel, it appear that the common iliac is of unusual length, and the disease have involved the coats of the vessel close to the bifurcation, it will be necessary to apply the ligature at once upon the common iliac artery.

Demerits.

Mr. Abernethy's operation.

This operation consists in an incision through the abdominal parietes, to the extent of from three to four inches. (*See* fig. 3.) The patient should be laid quite horizontally on a table, for the purpose of keeping the muscles in a moderately tense condition, the head being raised on a pillow. The line of the vessel should, as in the case of the internal iliac, be marked out with ink. The integuments being divided to the above extent, commencing at the distance of four inches above Poupart's ligament, the stratum of fat and cellular tissue, which bears the name of superficial fascia, should be divided down to the level of the aponeurosis of the external oblique muscle. If in this division of the fascia, the superficial epigastric artery bleed freely, it should be tied, for much of the success of the after stages of the operation depends on the wound being kept clear of blood. The aponeurotic tendon of the external oblique should be cut asunder in the same direction, continuing the incision downwards, to within one inch of Poupart's ligament.

Avoid the spermatic cord.

To the same extent is the division of the internal oblique and transversalis muscles to be made; care being taken to leave untouched the spermatic cord, emerging below the lower border of these two muscles. The muscles should be fully divided *nearly* to the extent of the outer wound. The fascia transversalis is then brought into view, and should be carefully divided on a director, to the length of the division in the muscles. The peritoneum is now exposed. By easy manipulation, with a clean hand, and with the nails reduced, if necessary, to an ordinary length, and not projecting beyond the extremity of the fingers, the peritoneum is to be drawn inwards from the iliac fossa, with the left hand for the artery of the left side, and *vice versâ*, towards the mesial line of the abdomen, with the intestines enclosed within it. The psoas magnus is then brought into view, and upon its inner side lies the external iliac artery, advancing forwards on to its anterior surface. The extent of the disease is now perceptible by the exposure of the artery, for three to four inches above Poupart's ligament. With a silver or other blunt knife, the fascial sheath investing the artery should be divided at the part of the vessel around which it is intended to apply the ligature, the coats of the artery fully exposed to the eye, and the genito-crural, a very small nerve, avoided if in contact with it. The peritoneal bag may be held off the vessel on the left side, by the two fingers of the operator; if on the right, by the application of a sufficiently broad retractor. One end of the ligature should be brought out at the lowest extremity of the wound, which may be united, as regards the muscles, by apposition alone; the trunk of the patient being bent forward in the semi-recumbent position, and sutures applied through the wound in the integuments.

Sir A. Cooper or Frcer's operation.

The operation of Sir A. Cooper consists in a semi-lunar incision, made in the direction of the fibres of the external oblique muscle. (*See* fig. 3.) This incision is commenced about an inch from the anterior superior spine of the ilium, and carried downwards across the artery, nearly as far as the external abdominal ring. The convexity of this arch looks downwards towards Poupart's ligament. Mr. Norman's external incision varies from the above, in being formed by a straight line parallel to that ligament. The aponeurosis of the external oblique is now divided by a second incision, corresponding with the first, which exposes the spermatic cord, descending from the lower border of the internal oblique, to enter the inguinal canal. The cord is raised with the cremaster muscle and fascia investing it, and drawn upwards with a blunt hook. All that now remains is to divide the fascia transversalis, where it forms the posterior boundary of the inguinal canal, which may be effected by the introduction of a director along the line of the canal. Underneath this fascia the artery will be readily exposed, if care has been taken prior to the operation to ascertain its exact course. The vein lies to its inner side. The sheath of the artery should be detached from it, and the armed needle passed underneath it from within outwards, or *vice versâ.*

Mr. Travers' case, involving branches.

It would be desirable, if possible, without unnecessarily detaching the sheath of the vessel, to ascertain the relations of the epigastric and circumflexa ilii arteries, to the part of the iliac trunk around which the ligature is about to be applied. The operator will call to mind the well-known case of Mr. Travers, in which the iliac artery was tied between the origins of these two vessels, and which operation proved fatal, by the current of blood being maintained in the artery up to the ligature, and passing into the epigastric, which was given off above it. The inner structures should be replaced as much as possible in their natural position, and four or five fine sutures employed to unite the fibres of the aponeurosis of the external oblique muscle, and two or three larger sutures applied to the lips of the external wound.

In both of the above operations, slight pressure should be made, by means of wadding, over the divided parts.

If it be intended to tie the artery *immediately* above

Mr. Norman's operation when applicable.

Poupart's ligament, I consider the straight incision of Mr. Norman preferable to the semi-lunar incision of Sir A. Cooper. If any doubt remain as to the extent of the disease, the semi-lunar incision is more desirable, inasmuch as it permits of a somewhat more extensive exposure of the vessel above the ligament. If, on its exposure, however, disease, contrary to expectation be found to exist, the longitudinal incision of Mr. Abernethy should be made upwards, through the inner muscles, in the direction of the artery.

For wounds, &c. of the epigastric and obturator arteries, *see* HERNIÆ.

## OPERATION FOR TYING THE FEMORAL ARTERY.

Relative anatomy.

The thigh is invested with a layer of fat and fibrous tissue, of about half an inch in thickness, called the fascia superficialis. This fascia, as it is termed, separates the skin from the fascia lata, while it gives a rotundity to the thigh, and forms a bed for the transmission of the superficial veins of the leg, for absorbents and lymphatic glands. The saphena major vein lies in the substance of the superficial fascia, as it ascends along the inner side of the thigh, to pour its blood into the femoral vein, about two inches below Poupart's ligament. The course of this vein can usually be ascertained by pressure upon its trunk in the upper and inner part of the thigh. Here it approaches so near the artery as to render this knowledge requisite before proceeding to an operation on this part of the vessel.

Relation of artery to skin.

The fascia lata forms a dense sheath around the muscles, and its presence is readily ascertained during the progress of any operation on the thigh requiring its division.

The femoral artery commences at Poupart's ligament, and terminates at the lower end of Hunter's canal, in the popliteal. Its direction is indicated by a line drawn from the central point, between the anterior spine of the ilium and the symphysis pubis, to the inner border of the patella, so long as the foot rests upright on the heel. Underneath this line, the artery will be found at varying depths throughout the thigh. The utility, however, of this rule is restricted to a little beyond the upper half of the thigh, for in the lower half, the artery leaves its anterior aspect, and plunges in among the muscles, for the purpose of making its way round the bone into the popliteal region. In the lower half of the thigh, operations on the artery are comparatively rare, and it is in the upper half therefore that the chief interest of this vessel lies, and of this portion the first six inches is the most important. Underneath Poupart's ligament, the femoral artery approaches the skin, lying upon the psoas magnus, about one-third from its inner margin. Its pulsations in this situation are rendered less distinct than they become lower down in the track of the vessel, by reason of the tension of the ligament across it. Below the ligament, the artery descends, both in its vertical, and in its longitudinal direction, into the hollow formed by the adductor longus muscle, arising from the os pubis and inserted in the middle third of the femur, and the vastus internus, on its outer side, descending in a straight line down the thigh. Here, at an average distance of five and a half inches below Poupart's ligament, the vessel is crossed by the sartorius muscle, which lies upon the artery for some inches. In this part of its course the femoral artery lies, to the extent of about one inch and a half, on the psoas, and from that point, till the vessel reaches the adductor longus, it is entirely unsupported. The femoral vein lies on the inner side of the artery, upon the pectinæus muscle, while underneath Poupart's ligament, and occasionally on the bone, when that muscle is smaller than usual. At the distance of two inches below the ligament, the vein begins to pass behind the artery, and in five to six inches the vein is entirely behind it, and it continues in this relation throughout the rest of its course. Two and sometimes three nerves occasionally accompany the femoral artery, one of which, the nervus saphenus, gains its front surface about four or five inches below Poupart's ligament, viz., where the artery is crossed by the sartorius muscle. The saphenus nerve descends in front of the artery, to Hunter's canal, there crosses obliquely over to its inner side, and becomes cutaneous on the inner side of the knee-joint.

Anatomy of upper third most important.

Relation of vein.

At a distance, varying from one inch and a half to

Profunda.

two inches and a half below Poupart's ligament, the femoral artery gives off the profunda, a vessel of nearly equal size to the femoral itself, which descends to its outer side, and subdivides in many secondary branches, for the supply of the muscles on the outer and posterior part of the thigh. The femoral artery and vein are surrounded by a sheath of fibrous tissue, which increases in density as the vessel descends. This sheath acquires considerable firmness in the middle third of the thigh, being of a true fibrous character. The last three inches of the femoral artery, so called, lies in the tendinous canal, formed by the tendons of the adductor longus, magnus, and vastus internus, having the vein behind and the nervus saphenus in front of it.

Operation.

The femoral artery is generally tied for popliteal aneurism, but its obliteration by operation is equally required by the presence of any aneurism along its course, as well as by any wound. The part of the vessel usually selected for the ligature, is that at which it is crossed by the sartorius muscle; viz., from five to six inches below Poupart's ligament. The reason why this part of the vessel is chosen, is, first, because the distance above the disease, when in the ham, is sufficient to ensure the great probability of a healthy condition of its coats; secondly, because it is sufficiently far below the origin of the profunda, to ensure the formation of an undisturbed coagulum; and, thirdly, because the artery is there readily accessible to the operator. It has been stated that the profunda artery arises from the femoral, at a distance varying from one inch and a half, to two inches and a half, from its commencement; but we occasionally find this large vessel arising as low as three inches and a half from its parent trunk; and if in such a variety the femoral trunk were tied at a distance of four inches or four inches and a half, the result might prove that the space left was not ample for the formation of a coagulum.

Underneath sartorius.

In operating on the femoral for popliteal aneurism, it is more prudent to apply the ligature at least six inches below the ligament, where it lies, at some slight distance, underneath the sartorius muscle itself, and not merely where covered by its inner margin.

Course of

The thigh should be fully extended, everted, and the knee bent. The course of the artery ascertained by sartorius and saphena vein.

pressure of the finger, and dotted with ink on the skin. The course of the sartorius should also be ascertained, by holding the leg in an extended position, and desiring the patient to bend it inwards. This movement being effected by the sartorius, the outlines of the muscle will become apparent. If the deposit of fat be unusually large, a line may be drawn obliquely across the artery, from the anterior superior spine of the ilium, to a distance of six inches below Poupart's ligament. The course of the saphena major vein is also to be ascertained, and this knowledge may be acquired by pressure on the vein in the upright position. The line should also be dotted with ink.

These preliminary inquiries being fully made, an incision of little more than two inches in length, in a limb not more than usually invested with fat, will suffice, and this incision should be made from within outwards, obliquely across the artery, at an angle of about thirty degrees, and across the fibres of the sartorius, care being taken to avoid either the saphena vein or its branches (*see* fig. 3). This incision may be made freely, and the parts divided down to the fascia lata, lying at the depth of about half an inch from the skin. The fascia lata may be divided in the same direction, but for which purpose the knife must be used more cautiously. When the fascia lata is divided, the sartorius muscle is brought into view. Some doubt occasionally arises in the mind of the operator whether the fibres now exposed are really those of the sartorius muscle; but if the line of the incision be correct, they can belong to no other muscle. These fibres should be raised on the inner side of the artery, and hooked, or pushed outwards, when the sheath of the vessels will be seen below. If the sartorius muscle, as occurs in powerfully muscular subjects, be unusually broad, the distance between the exposed part of the muscle and its inner border may be greater than usual, but that is no reason for dividing it. The operator should work round it to its inner border, which he may do without difficulty, or any important loss of time. The presence of the sartorius muscle is, perhaps, the surest guarantee that the artery is about to be exposed in the best situation, and forms the safest guide to the further progress of the operation. The finger being now applied to the bottom of the wound,

Sartorius muscle the best guide.

the pulsations of the artery will be distinctly felt. The sheath should be divided to the extent of about half an inch, the artery a little separated by means of a silver knife, and the needle passed around it in either direction, care being taken neither to wound the vein, which it is inferred has been sufficiently separated by the previous manipulation, nor to include the saphenus nerve, which, if exposed, should be separated from the outer side of the vessel.

Case of wound.

The femoral artery, like other vessels, particularly of the extremities, is liable to wounds, requiring the application of a ligature in any part of its course. Several such examples have occurred to myself. One of these I have mentioned in the introductory chapter to this subject. A second case of this kind occurred to me in the year 1831, while on duty for my late friend Mr. Earle, which presents peculiarities of interest to the practical surgeon, and which I will briefly relate. A man was brought into St. Bartholomew's Hospital, having received a punctured wound in the direction of the femoral artery while involved in Hunter's canal. The wound was made by a clasp-knife, in the endeavour to open an oyster by placing it between his knees. From the formidable nature of the hæmorrhage, and the direction of the puncture, I had little doubt that the femoral artery was wounded in Hunter's canal. Unwilling to perform so serious an operation single-handed, by lamp-light, (for the case occurred during the night,) I put a firm compress on the puncture over the artery, and rolled the limb tightly up to the groin, placing a tourniquet upon the upper part of the femoral artery. On the following morning, a consultation was held, and while discussing the case at the bedside of the patient, the hæmorrhage returned with fearful violence, and it appeared that the roller encircling the man's limb was saturated in an instant. The patient was removed to the operating theatre adjoining this ward, and I tied the femoral artery above and below a large wound in its coats while in the tendinous canal of the adductors. The man was placed in a bed in the same ward from which he had been removed, and progressed for some days favourably. It happened at that time that a severe case of sloughing phagedæna had existed in the hospital. The subject of this disease died, and the ward was whitewashed and fumigated; the remaining patients being dispersed about the hospital. One of these, a boy, had axillary abscess, who was taken charge of by the sister of the ward, and accompanied her to a ward on the ground-floor, to which she was removed. Two days after the puncture of the abscess, the boy's wound became phagedænic, and I ascertained that the sister had carried down with her all the apparatus of her calling, in the form of sponges, towels, &c., that she had originally used in the phagedænic ward above. I desired that the boy should be taken again into an upper ward, and kept free from the contact of the patients. Unfortunately, he was placed in the same room with my case of punctured artery. In four days from his arrival, the stump of a case of amputation, I had performed ten days prior, became phagedænic; and a second case of Mr. Stanley's, in the opposite bed, showed the same action, and I removed my aneurism case to the extreme end of the ward; but the man obstinately refused to leave the ward. On the fifteenth day the ligatures were firm, but the wound looked glazy, and inflamed round the margin. I desired the house surgeon to keep a tourniquet permanently around the thigh. On the sixteenth day the ligature came away suddenly, as it seemed, without effort; and on the seventeenth, hæmorrhage returned with the same violence as before; two pints of blood were supposed to have been lost before the tourniquet could be tightened. This occurrence also took place at night. The man was pulseless, with the hue of death on his face. In this condition, from which he was rallied only by great perseverance in repeated stimuli and friction, I tied the artery immediately below Poupart's ligament, and above the profunda, having resisted the urgent recommendation of others to amputate the limb at the hip-joint. The man eventually, but slowly, recovered.

Ligature of the femoral in Hunter's canal.

The femoral artery is occasionally tied in that portion of its course where it lies in the tendinous sheath, which is called "Hunter's canal." This operation is a difficult one. Our guide to the position of the vessel is the tendon of the adductor magnus muscle. This can be felt through the skin, and it must be carefully traced from the condyle upwards. The thigh is placed upon its outer aspect with the leg bent at a right angle. An incision is made towards the lower portion of the middle third of the thigh (*see* fig. 3), along the anterior border of the adductor magnus muscle, to the extent of three or four inches. It must be sufficiently free. Superficial and deep fasciæ are divided, and muscle exposed. This will be either the sartorius or vastus internus. If the *former*, the fibres are *longitudinal;* if the *latter*, they are *transverse.* The sartorius is to be drawn to the *inner*, and the *vastus internus* to the *outer* side; and the dissection continued until the tendinous sheath is exposed. This is carefully divided, and the artery may then be felt, and, with a little cautious separation, seen. It lies superficial to the vein, with the saphenous nerve in front of it.

If the artery be sought for too low down, the difficulty of the operation is considerably increased; for it becomes much deeper as it begins to pass into the popliteal space.

## OPERATION FOR TYING THE POPLITEAL ARTERY.

Relative anatomy.

The name popliteal is given to the artery from the point of its emergence out of Hunter's canal, to that of its division into the anterior and posterior tibial. In this part of its course it is inclosed in a space of lozenge form, or rather of two isosceles triangles of different sizes, connected at their base. Of these the upper one is formed by the two masses of muscle, which diverge from each other to form the ham-strings. The inner mass, being composed of the semimembranosus, semitendinosus, gracilis, and sartorius, the outer by the biceps inserted below into the fibula. The lower triangle is formed by the divergent heads of the gastrocnemius muscle, and is more nearly equilateral. These triangles are united at their bases. Into this space the artery enters at the upper and inner extremity, passes obliquely to its centre when between the condyles, and retains the mesial line throughout the rest of its course, lying in the two upper thirds in contact with the bone, then upon the posterior ligament of Winslow, and, finally, upon the popliteus muscle. In the upper half or more, the vein lies upon the artery, in immediate contact with it, and a little to

Popliteal vein.

its outer side. At the lower end of this space the vein often lies a little to its inner side. The division of the ischiatic nerve takes place usually above the popliteal space, into the popliteal and peroneal of which the inner or larger branch lies superficially to the vessels beneath. These vessels are invested by a well-defined sheath.

The popliteal artery furnishes at least six branches to the knee-joint, and to the muscles of the calf of the leg. For the most part they are all produced from about the middle part of the course of the vessel, and several are sufficiently large to demand consideration in the operation for tying the trunk of the vessel in this situation. Across the popliteal space, a band of fascia, composed of transverse fibres, extends, which is lost on each side in the muscles which bound it, and by which the vessels and nerves are protected from injury. In the straight position of the leg this fascia is quite tense. The popliteal space is for the rest filled up with fat and some absorbent glands. At about the middle of the space the external saphena vein or saphena minor enters to pour its contents into the popliteal vein.

Bend of knee.

The popliteal artery, although the most frequent seat of aneurism, is rarely the subject of operation. It is generally affected by disease in that part of the vessel that corresponds with the flexion of the knee.

Bifurcation.

But aneurisms of the bifurcation of the popliteal into the tibial arteries have been described by Mr. Hodgson and others; and for such diseases the operation of Mr. Hunter is almost invariably resorted to; indeed, I have never seen this artery exposed in a case of aneurism, so universal is the practice of the Hunterian operation, and so especially applicable to this region.

Operation.

With a view to its exposure, the patient should be laid on his face, and in this position, with the leg moderately extended, the outline of the popliteal space is well defined. The course of the artery may be traced over the skin, and the situation of the external saphena vein clearly ascertained. The popliteal artery may be tied in its upper or lower half, viz., either where it lies on the femur, or on the ligament of Winslow and popliteus muscle. In either case the incision may be made in the oblique direction, to the extent of about two inches and a half. By this incision the skin and popliteal fascia should be fully divided, to a sufficient extent to expose the line of the artery lying at the bottom of the wound. The rest of the operation should be performed by a blunt knife, by which the cellular structure about the vessels should be separated, but with as little violence as possible. At the upper half, the connection between the artery and vein is exceedingly close, and they are separated with difficulty. In the lower half, the saphena minor may be exposed, and should be drawn with the popliteal nerve to the outer side.

## OPERATION FOR TYING THE ANTERIOR TIBIAL ARTERY.

Relative anatomy.

The anterior tibial artery is deeply placed among the muscles of the front of the leg, where it penetrates the interosseous ligament; it lies at a depth of an inch and a quarter from the surface. Descending, it gradually approaches the surface, and on the dorsum of the foot it is placed immediately under the skin. The artery occupies the front of the leg at the bottom of a deep fissure, formed between the tibialis anticus muscle, on its inner side, and the extensor communis digitorum and extensor pollicis, on the outer side. In more than the upper half of this course the vessel lies on the interosseous ligament; in the lower half, or somewhat less, it lies on the tibia, the increasing breadth of which encroaches on the ligament. The tibialis anticus muscle fills the hollow of the tibia. It arises from this bone, and from an aponeurosis, in common with the extensor of the toes on its upper surface, which covers the fissure between these muscles. In the middle third, the origin of the extensor of the great toe gives a new relation to the artery, which is now placed between it and the tibialis. Reaching the angle, the anterior tibial passes over the front of the tibia, over the astragalus, navicular and middle cuneiform bones. In this course it is first crossed by the tendon of the extensor pollicis, and on the foot by the first tendon of the extensor brevis digitorum passing to the great toe.

The anterior tibial artery, as is the case with all the arteries below the knee, is accompanied by venæ comites, having frequent irregular communications with each other, across the vessel. The anterior tibial nerve lies in front of the artery and to its outer side, but in its descent down the leg crosses the artery to its inner side.

Important outline of tibialis anticus.

The tibialis anticus is the most important guide to the artery, and its outline should be fully ascertained. This may be done by holding the foot down in extension, previously pressing the toes upwards in extension. By this latter action the common extensor is carried out of the sphere of its action. By then making the attempt to raise the foot inwards, the outline of the tibialis anticus will become apparent. On the dorsum of the foot, the pulsations of the artery are perceptible by careful examination, with the foot elevated. The anterior tibial communicates with the posterior tibial, more or less indirectly, by the terminal branch, descending to join the external plantar, by the external malleolar branch, inosculating with the peroneal, and by other small branches that maintain great freedom of communication.

Operation.

The anterior tibial artery is rarely tied for aneurismal disease, but the operation is resorted to in cases of hæmorrhage from wounds of this vessel, in which two ligatures are necessary. It is an operation of little difficulty, if the anatomical relations of the artery be sufficiently known. The breadth of the tibialis anticus should be clearly defined, on the outer border of which, distant from the tibia about an inch and a quarter in the upper third of the limb, the fissure between it and the common extensor of the toes is found. Along this line an incision should be made, nearly longitudinally, to the length of about two inches and a half, and something more than this, if the muscular development be large. The incision should be made nearly longitudinally; and therefore contrary to the rule I have laid down, in consequence of the depth of the vessel from the skin (*see* fig. 4). If the outer wound be made obliquely across the vessel, then it will hardly be sufficiently dilatable, unless made at very unnecessary length.

The fissure being exposed, the muscles are to be separated from each other by the handle of a scalpel, and the foot is to be pressed upwards in flexion, with the toes extended in the same direction. At the bottom of the fissure the pulsations of the artery will be felt, and the vessel exposed. The needle should be passed around it, without including either of the veins, if prac-

Different relations in lower part of course.

ticable. If it be required to tie the vessel in the lower part of its course, the external incision should be made nearer the tibia; the fissure being now formed by the tibialis anticus and the extensor pollicis, which may readily be detected by putting that muscle into action. It is hardly necessary to say, that the nerve should be drawn aside if brought into view. Supposing the anterior tibial to be wounded, either through the substance of the tibialis anticus, or through that of the other muscles on its outer side, it is better on principle, and on the grounds also of greater facility, to follow the above rules, which are unerring, than to attempt a further division of the muscles for the purpose of reaching the artery. I consider such division of muscles, unless absolutely necessary, to be most objectionable.

## OPERATIONS FOR TYING THE POSTERIOR TIBIAL ARTERY.

Relative anatomy.

The course of the posterior tibial artery corresponds with a line drawn from the centre of the ham to the middle of the malleolus internus. In the two upper thirds of its course it is covered by the muscles of the calf, the gastrocnemeus and soleus. In the lower third, emerging from the inner side of the calf, it descends along the inner side of the tendo Achillis, and is covered only by integument, fat, and deep fascia. In the upper third it is nearly two inches from the inner border of the tibia; in the middle third, one inch and a quarter; and in the lower third, about half an inch. In the upper third it lies on the tibialis posticus muscle; in the middle third, on the flexor digitorum; and in the lower third, either on the tibia itself or on the tendons of the two last-named muscles. It has venæ comites throughout its course, of very irregular and uncertain size. The posterior tibial nerve lies to its inner side for about three inches of its course, and to its outer side throughout the remainder of the leg below. The posterior tibial artery, veins, and nerve are bound down to the deep-seated muscles, by a layer of tolerably dense fascia, which protects them from the action of the muscles of the calf.

This is the relation of the artery to the surrounding parts ; but, with a view to expose the vessel when required, it is necessary to say a few words on the subject of the muscles of the calf. The gastrocnemeus arises by two heads from the condyles of the femur, and terminates in the tendo Achillis, at a distance of two or three inches above that of the soleus, which is inserted into the broad tendon, chiefly on its anterior or deep surface. This latter muscle arises from the inner border of the tibia, and from the fibula. The origin from the tibia occupies nearly half of the length of the bone. In reflecting this muscle from the tibia, the origin of the long extensor of the toes should be carefully avoided, because it forms a guide to the level of the artery. If the fibres of the extensor be raised with the soleus, the dissection will be carried on between the artery and the bones, instead of directly along the surface of the fascia. The saphena minor vein ascends along the middle of the calf of the leg, to join the popliteal vein in the ham, and this vein is accompanied by a considerable branch of the posterior tibial nerve. Both of these objects lie in the fissure between the two fleshy bellies of the gastrocnemeus muscle.

**Attachments of soleus.**

Although nearly beyond the pale of liability to true aneurismal disease, the posterior tibial is the object of occasional operation. Its large size, and its profound depth, also render it a vessel of peculiar interest to the operating surgeon. To expose it in the upper part of its course, requires the performance of an operation that may reasonably be termed difficult, and the more so in proportion as the operator has taken less pains to perfect himself in the relative anatomy of the vessel. Descending in the very centre of the leg, bounded posteriorly by the immense and fleshy muscles of the calf, it appears to defy the art of the surgeon in his attempt to arrest hæmorrhage from a wound in its coats. The posterior tibial may be exposed in either one of two directions, first, by a deep incision through the calf of the leg ; and, second, by an incision along the inner side of the tibia, by which the muscles of the calf shall be raised from off it. In favour of the first of these operations, the name of Mr. Guthrie may be quoted, who has had larger opportunities of testing the value of operations of this description, than fall to the lot of most surgeons. Mr. Guthrie

**Operation.**

**Two modes.**

**Longitudinal incision through the calf.**

recommends an incision through the muscles of the calf, of considerable length, down to the artery. This incision must be made in the centre of the gastrocnemeus and through the soleus muscle, the patient being laid on his face, or nearly so. Each muscle must be carefully divided, and at the bottom of a wound so made, the artery and nerve lie covered alone by the deep fascia of the leg.

Reflecting origin of soleus.

The other operation for tying this artery in the upper third of its course, and that more frequently resorted to, requires the separation of the soleus from its origin in the tibia. For this purpose the patient should be laid upon the side and the knee bent, the origin of the soleus clearly defined, and the course of the saphena major vein ascertained, and avoided, if possible. If, however, the vein or any of its branches should be found to cross the required line of division of the skin, it must share the fate of the integuments, and be divided with them. An incision, varying in length from three and a half, to four and a half inches, or even longer, in proportion as the calf is large, should be made, commencing below the head of the tibia, and carried obliquely backwards, and terminating at a distance of full three-quarters of an inch *posterior to the inner edge of the bone* (*see* fig. 3). The parts exposed should be divided until the origin of the soleus is clearly brought into view. This muscle should then be separated at its origin from the tibia, to the extent of three and a half inches, or more, care being taken to leave the deep fascia attached to the tibia. It is highly important, in this stage of the operation, to distinguish and separate the fascial surface of the soleus muscle, from the deep fascia separating that from the deep-seated muscles. If the heel be now drawn upwards by full extension of the foot, the muscles of the calf will be relaxed, and should be drawn outwards by two fingers forced underneath them. Supposing the wound to be too small to reach the artery without difficulty, it should be enlarged in either the upper or lower direction. This being effected, the artery will be felt about midway across the calf, and while lying on the tibialis posticus muscle.

Relation of nerve.

But the proximity of the veins and nerve to the artery demands free incisions, and a sufficiently wide opening, arising from the necessity of dividing the fascia covering it at this depth. It should be recollected that the posterior tibial nerve is internal to the artery for some three or four inches down, and that it lies upon the artery for an inch or two still lower. The fascia should be divided while the calf is drawn from the bones by an assistant, the knee being fully bent on the thigh, and the foot as fully extended on the leg, and the artery brought clearly into view. As this operation is generally resorted to in the case of wounds, a double ligature is required; and these should be applied separately around the vessel, unless the difficulty of surrounding the artery be very great; but, considering the tendency in wounds in the coats of arteries to gape, it is always preferable to apply two single ligatures to one double one, the threads of which have to be separated from each other to a considerable distance, longer, indeed, than it has proved feasible to separate the artery from its surrounding tissue. The operation being completed, the soleus should be replaced, and the leg placed on a pillow in bed, still retaining a partially bent position. By these means the soleus will recover its attachment to the bone.

Relative merits of the two operations.

In regard to the respective merits of these two modes of exposing the posterior tibial artery in the first part of its course, we must take into consideration, first, the facility of effecting the primary object of the operation, viz., the arrest of hæmorrhage, and, second, the question of the restoration to health of the structures divided by the knife. With regard to the first of these questions, much will depend both on the experience of the operator in the use of the knife and on his intimate knowledge of the region he is about to operate on. Some consideration is also due to the size of the calf of the leg in the subject of the operation. When the calf is large, the distance of the artery from the surface is nearly equal, if measured vertically to the centre of the calf, or to the inner border of the tibia. If the artery were divided by a puncture vertical or nearly vertical, along which a probe would pass down to the vessel, it might be a temptation to follow the line of puncture. The artery here lies in the middle of the leg, and it must be recollected that although the gastrocnemeus muscle may be divided in the centre *between* its two fleshy bellies, yet the soleus, a non-symmetrical muscle, is fleshy in substance throughout its entire breadth. It is easier by far to follow the

Objections to posterior operation.

line formed by the surface of a fascia than to expose its surface by vertical incision through muscle. There is every difference between the exposure of the fascia lata, for example, through integument and fat, and that of the deep fascia of the leg through muscle; and I conceive that it would be less difficult to reach the line of this fascia from the tibia, and to follow it outwards, than to reach its surface from the calf, because, being very thin, it might be unconsciously divided at the bottom of a wound discolored by blood, when the dissection would at once extend into the deep-seated muscles beneath it, and it should be recollected that muscles divided by the knife bleed freely. The objection to the posterior operation consists in the necessity of making a long and deep division of large and important muscles, which, although made in the direction of their fibres, is calculated to endanger their future integrity of action as well as of structure, and on the entire recovery of which depends the future gait of the individual; for although a complete and early union of the entire wound may be unattended with evil, yet this union may be slow, or it may be imperfect, consequent on inflammation, or on suppurative action being established in the course of the treatment. Should such results follow the operation, the function of these muscles may be impaired for life, and permanent lameness follow. The objection to the inner operation consists in the inextensible nature of one-half of the wound made to reach the artery, and the difficulty of sufficiently drawing back the muscles to reach the requisite depth. Still this evil may be obviated by the first incision being made ample in length, *behind* the line of the tibia, and oblique in direction, and also by position, the foot being fully extended, and the knee much bent on the thigh. On the whole, while I consider the difficulties attendant on the inner operation to be greater than those of the posterior one through the calf, I am disposed, under all circumstances, to prefer it, considering the greater liability to subsequent injury to the actions of the calf by the latter operation. I have done the inner operation on several occasions, both by day and by lamplight, and I have not found the difficulty by any means insuperable.

Objections to inner operation.

Preference to inner operation.

Operation

The operation for tying the posterior tibial in the lower half of its course is comparatively simple. In the middle of the leg the artery lies on the common flexor of the toes, at a distance of about one inch or more from the inner border of the tibia. The soleus muscle is attached to the bone, somewhat below the middle, and therefore its separation from the tibia may be required in an operation on the artery, midway down the leg. In the lower third the artery lies on the tendons of the common flexor and tibialis posticus muscles, at a distance from the inner border of the bone of about three-quarters of an inch.

below the middle of the leg.

In this operation, the external skin, fat, and deep fascia alone require division, by an oblique incision over the course of the artery (*see* fig. 3), which lies at the depth of about three-quarters of an inch from the surface. In passing behind the inner ankle the artery lies behind the tendons of the two last-named muscles, accompanied by its venæ comites, and having the nerve on its outer or peroneal side. Keeping in mind these various relations, the posterior tibial is readily exposed in any part of the lower third of its course.

Operation behind inner ankle.

It is important that the relations of these various structures above and behind the malleolus internus should be well understood in reference to the operation of tenotomy for talipes varus. The close proximity of the tendon of the tibialis posticus to the artery diminishes above, and we therefore select a distance of an inch or two above the ankle-joint for the safe division of the tendon of the tibialis posticus. No doubt the artery has been frequently divided in this operation.

## OPERATION FOR TYING THE PERONEAL ARTERY.

From its origin, the peroneal artery, passing outwards at a very acute angle with the posterior tibial, towards the fibula, and reaching the level of the origin of the flexor pollicis muscle, passes underneath it, along the line of the attachment of the interosseous ligament into the fibula, and it terminates below by inosculations, both in front and behind the outer ankle, with both anterior tibial and plantar branches of the posterior tibial arteries. The peroneal artery, therefore, lies in a groove formed by the fibula, flexor pollicis, and interosseous ligament.

Relative anatomy.

Difficult as the exposure of this vessel may be, the attempt to tie it at the point of injury is preferable to the performance of the operation for obliteration of the femoral or even of the popliteal artery.

Operation.

The outline of the fibula being clearly marked, an incision of four inches in length should be made obliquely downwards, behind it, to the extent of three and a half or four inches. This incision should be made behind the peronei, which envelope the outer side of the bone. The object next to be accomplished is that of separating the soleus and its tendo Achillis from the last named muscle, by which the flexor pollicis muscle is exposed to view. The great toe being as much bent downwards as possible, the flexor muscle should be encircled by the finger introduced into the wound for this purpose. The finger being passed around the muscle to its inner side, the muscle should be drawn outwards and forwards, and detached from the interosseous ligament, underneath which the artery will be felt. It may occasionally, when the muscle is large, be a preferable course to separate the flexor pollicis from the fibula, and expose the artery without separating the muscle from the interosseous ligament, or, if necessary, the muscle may be divided across.

Transverse wounds.

In the case of a punctured wound entering the leg on the inner side, followed by hæmorrhage, the source of which may be uncertain, whether derived from the posterior tibial or peroneal, the operation for tying the posterior tibial artery should be performed. If the artery be found entire, and the evidence point, as it necessarily would, to the peroneal artery as the source of hæmorrhage, the wound should be increased to a sufficient length to permit the wounded peroneal artery to be exposed from its inner side, by pushing back the flexor pollicis muscle, and separating the superficial from the deep-seated muscles of the calf.

## OPERATION FOR TYING THE DORSAL ARTERY OF THE FOOT.

The dorsal artery of the foot may be readily exposed by an oblique incision of an inch in length, commenced on the outer side of the extensor tendon of the great toe (*see* fig. 4). Here the pulsations of the artery are generally felt with distinctness. A little below the middle of the foot, the dorsal artery is crossed by the first tendon of the extensor brevis : an oblique incision cannot fail to expose the artery to view.

## OPERATION FOR TYING THE EXTERNAL PLANTAR ARTERY.

The external plantar artery passes obliquely outwards from the inner to the outer side of the foot, where it lies beyond the outer edge of the middle portion of the plantar fascia.

In order to expose it, an incision should be made nearly across its course, taking the inner side of the metatarsal bone of the little toe as the starting point. From this point an incision of about one and a half inch in length should be made in the direction of the ball of the great toe. The artery, imbedded in a good deal of fat, will be found at a distance of about half an inch from the inner side of the bone, close to its articulation with the os cuboides.

# CHAPTER IX.

## ON NÆVI MATERNI AND ERECTILE TUMOURS.

### NATURE—VARIETIES—TREATMENT.

Definition.

By the term *nævus maternus*, is understood a mark, or spot, or mole, on the skin, which is usually, if not always, congenital, and due to some abnormal condition of the integument, characterised especially either by some unnatural deposition of pigment, or by considerable increase of the smaller vessels. Erectile tumours, to use the term in its general sense, consist in a congeries of vessels, which have been supposed to possess some form of local action of their own, independent of the general circulation. Under this term we include a form of disease that may originate in any part of the body, and present itself at any period of life.

Varieties of nævi.

Nævi are either cutaneous or subcutaneous. The vascular cutaneous nævi consist of dilated capillaries, while the subcutaneous forms are composed both of dilated arteries and veins, of which the latter usually predominate in a very marked degree. As the disease advances, these enlarged veins become more and more dilated, and form cells which communicate freely with each other, in which the venous coats are generally easily recognisable. Probably capillaries also enter into their composition, the presence of which are indicated by the nearer approach to the arterial colour in any given tumour, and by the greater or less rapidity with which the condition of the tumour responds to the increased action of the circulation; and by the greater or less activity of the growth of the tumour. Sometimes they are so indolent as to remain stationary throughout life, without undergoing any perceptible increase in size; and when occupying a part of the body concealed by the dress, there is no excuse for subjecting them to surgical treatment. As a general rule, however, they increase considerably, and may, when favourably conditioned, reach an immense size, as has been stated by many old writers. They may be found in almost any part of the body, presenting the appearance of a cluster of vessels, more or less elevated above the surrounding skin, discoloured, of a reddish or purple tinge, and more or less soft to the pressure of the finger. If very soft, they are composed almost exclusively of vessels in which the venous system predominates. If more solid, they are composed of vessels united by a larger proportion of condensed cellular tissue. It is under the first of these conditions that the growth is occasionally rapid, and the hæmorrhage serious. When erectile tumours occur on any exposed part of the body, or show a tendency to increase, unless they have already reached a magnitude so great as to preclude the resort to surgical agency, they should be destroyed. To effect this object, many methods have been resorted to with more or less success by "*enterprising*" surgeons. These tumours have been, by various authorities, extirpated, compressed, insulated from their vessels by tying the arteries supplying them, subjected to ligatures applied around and through their base, and to circular incisions through the skin and blood-vessels around them, cauterization, acupuncture, injection, and vaccination. Of these numerous remedies few have stood the test of repeated experiment.

**Vaccination.** When an erectile tumour appears on the person of an infant that has not been vaccinated, it would be well to employ this agent as a first and simple experiment; and, if the tumour be not very large, two or three punctures should be made, into which the vaccine virus may be inserted. **Nitric acid.** Should this remedy fail, perhaps the most efficient remedy which remains, when the disease is principally cutaneous, is nitric acid. Mr. S. Cooper recommends the employment of the diluted acid. The advantage of this remedy is not very apparent, and the cure must necessarily be very tedious and uncertain. I have found the strongest acid that can be obtained the most efficacious. I have on many occasions employed nitric acid made by Mr. Taylor, of Vere Street, which is much stronger than that which is usually sold, containing only one equivalent of water, and the result was very successful. The advantage of the strong acid is, that its effects are immediate; that the destructive action is diffused throughout the substance of the tumour, and the injury to the skin is less considerable than that occasioned by the employment of the common acid of the London Pharmacopœia. This agent, however, should be applied with great nicety and care. The most efficient method of applying it is by means of a glass brush, which, if the disease be small, may be greatly reduced from the ordinary size; or it may be applied to the nævus by means of a solid cylinder of glass, and pressed on the part of the tumour on which it is intended to be applied, and repeated two or three times. In all probability, that portion will be destroyed, of which evidence will be obtained in the course of a few days, when, if necessary, the acid may be reapplied to the adjoining structure. Beyond the application of a little sweet-oil, or an occasional light poultice, no subsequent treatment is required.

Potassa fusa.

The potassa fusa, if pure, is also a good remedy; but its influence on the disease, either at the time or subsequently, is not quite so conclusive. Mr. Lawrence generally employs and prefers the potassa fusa to the nitric acid. When time is not an object, and more especially, where it is desirable that the skin remain intact, I have adopted for many years treatment by means of fine seton threads, introduced through the body of the tumour. For this purpose, a long and fine straight, or nearly straight, needle is employed, by which the thread of silk is passed through the diseased growth, and allowed to remain in the tumour. Each portion of silk is tied loosely over the tumour to its opposite end. A second, third, fourth, or indeed any number of threads may be passed across transversely, or obliquely, to the first; but chiefly taking the axis of the tumour as the guide. These threads, being tied upon the tumour, are destined to remain within it throughout the term of the treatment. Inflammation and lymph follow the line of their track, till the whole substance becomes condensed and solid, and the disease is gradually absorbed, or the same result is obtained by suppuration. The only instance in which I have known this treatment to fail was in the person of a child of one of the wardens of the model prison, in whom the disease was very large, and equally soft. The

Setons.

child wore the threads unsuccessfully for three months. Usually a month, or occasionally even a few days, will suffice to obliterate the tumour. I have never seen any injurious effects resulting from the presence of the threads; but should such occur, it is hardly necessary to say that they should be removed. The part should be covered with some form of dressing or poultice, to protect it against injury.

It would be needless to enter into the detail of the numerous remedies for erectile tumours that have been resorted to by surgeons of the last and present century, most of them being either inefficient, or in other respects objectionable. The following, however, may be referred to, rather for the purpose of warning the reader against their employment. Extirpation, unless wide of the disease, is necessarily attended with copious hæmorrhage, and its objection is obvious. Tying the arteries supplying it is next to impossible, and were it possible, would probably prove inadequate to the purpose. Pressure, injections of stimulating liquids, and breaking down the structure by means of a needle, prove equally inefficient, although each of these means is occasionally successful. Tying the tumour by means of a ligature applied around the base.—This mode of treatment is painful, and is productive of a deep cicatrix. It is, however, an efficient remedy when the tumour can be so insulated as to justify the resort to it. The difficulty of insulation is often remedied by the introduction of a needle through the base of the tumour, armed with a double thread. Each thread is to be carried round the corresponding half of the tumour, and tied very tightly; or when the tumour is large and difficult to isolate, the very ingenious plan of ligature devised by Mr. Fergusson may be adopted. It is described in his "Practical Surgery." When these tumours are situated on an exposed part of the body, it is especially important that that remedy should be selected which is least likely to leave behind it a permanent and unsightly cicatrix.

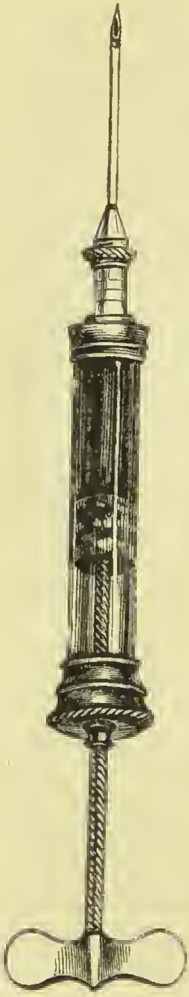
Extirpation.

Ligatures through, or around the base.

The perchloride of iron is a remedy of value in large nævi, involving an extensive surface of integument, the destruction of which is not only in itself objectionable, at the time, but insures an unsightly mark throughout life. It is applied by means of a fine screw syringe. This

Injection.

beautiful little instrument is here depicted. Its fine and sharp point readily perforates the skin, and its contents are injected by the slow application of the screw. A complete turn of the handle forces out a single drop, so that the quantity introduced can be most accurately determined. For an extensive nævus, of course several punctures are necessary, and these are repeated from time to time in various portions of the disease.



Breaking it up.

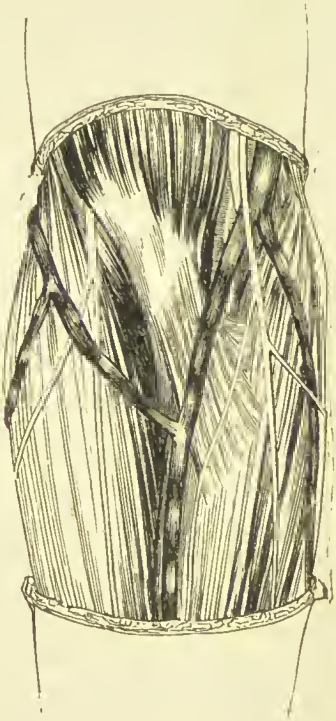
One other plan of treatment of subcutaneous nævi, when not too large, remains to be mentioned, which I have often practised with success. It consists in introducing a very fine knife under the sound skin near the margin of the tumour and cutting it up, or lacerating it with a probe. There is no escape of blood in this subcutaneous operation. Moreover, no skin is destroyed, and no cicatrix left, and this is an especial merit in certain situations.

# CHAPTER X.

## VENÆSECTION AND ARTERIOTOMY.

VENÆSECTION—RELATIVE ANATOMY OF PARTS AT THE BEND OF THE ARM—OPERATION OF VENÆSECTION—THROMBUS—LESS RARELY THAN FORMERLY RESORTED TO—LOCAL CONSEQUENCES—ARTERIOTOMY.

THIS operation is most commonly performed on one of the veins at the bend of the elbow,* sometimes on the external jugular, and occasionally, though very rarely, on other veins. In order to obtain an ample current of blood, it is necessary to compress the vein between the opening and the heart; the return of blood being thus arrested, the vessel becomes distended, and when punctured the blood escapes in a sufficiently large stream. In performing this operation at the bend of the elbow, we have usually the choice of three or four veins, the basilic, median basilic, cephalic, and median cephalic, (*see* plate,) the number, size, and position of the veins, however, vary greatly. Either the median basilic or median cephalic, is usually selected, the former is generally the larger of the two, but it



Front of right elbow.

Great varieties of relation.

---

* If no particular locality be mentioned, the bend of the elbow is the region referred to.

lies upon the brachial artery, or rather crosses it at a very acute angle, and is separated from it only by a thin layer of fascia, which passes off from the tendon of the biceps muscle; moreover, one or more branches of the internal cutaneous nerve cross over it. The median cephalic, although smaller, is free from these objections, the cutaneous nerves passing beneath it. But, if the operation be performed with care, the artery may be easily avoided; there is no excuse for wounding it. The young student may avoid all risk by selecting the other vein, which will generally be found to answer the purpose.

We are recommended to avoid, if possible, the selection of a vein on which the operation has been already performed. I doubt much if this advice be given on sufficiently valid grounds.

But the arteries also are subject to variety, and we must ascertain by the pulsation that no irregular branch lies underneath. A piece of tape or riband, about a yard and a half in length, and at least an inch broad, is secured round the arm, about three inches above the elbow; it is applied sufficiently tightly to arrest the circulation in the superficial veins, but not tight enough to interrupt the passage of the blood through the artery; this point is ascertained by feeling the pulse at the wrist. The patient is then directed to close his hand; by putting the muscles into action, the blood is forced into the superficial vessels; or he may at the same time support the arm by grasping the border of the operator's coat: a broom handle was formerly employed for this purpose. The arm being extended at right angles from the body, the front surface is turned forwards: it is much better to do this before the puncture is made, so that the position of the arm may not require alteration afterwards, for it often happens, as the result of a slight twist in the arm, that the apertures in the skin and vein no longer correspond, and the flow of blood is thus more or less impeded.

A third person being prepared with the vessel to receive the blood, the surgeon holding the lancet with the blade at right angles to the handle, between the thumb and forefinger of the right hand, (for the right arm, and *vice versâ*,) places the thumb of the left hand upon the vein, just below the spot where he intends to open it; this fixes the vein, and prevents it rolling from under the lancet, which it is otherwise very prone to do, when quite superficial. The escape of blood is moreover controlled, should the vessel be inconveniently placed for its reception. He presses the lancet by a sliding movement into the vein, and then by raising the point he makes the instrument cut its way out, describing the segment of a circle. The vein should not be opened in the exact direction of its long axis, but rather obliquely; by which means the edges of the wound will separate more freely.

**The lancet should describe a segment of a circle.**

A sufficient quantity of blood having been allowed to escape, the surgeon arrests the current by placing his thumb upon the vessel below the wound, and he immediately loosens the bandage. A small thick pad of folded lint, less than an inch square, is then placed upon the wound, care being taken to bring the edges in close contact, and it is secured by the bandage applied in the form of the figure 8, the ends being made to cross upon the pad. The patient should be directed to keep the arm quietly at rest. The bandage may be removed in about thirty-six hours.

**Edges brought closely together.**

In very fat subjects, particularly in women, the superficial veins are sometimes not visible; friction with the palm of the hand along the surface of the fore-arm will often assist in rendering them more prominent; immersion of the arm in warm water is rarely employed, but the plan may be tried, if the necessity for venæsection be urgent. As a last resource, one of the veins on the back of the hand may be opened. When the aperture in the skin is very small, or the position of the arm is changed, the flow of blood is often impeded, and it is liable to become infiltrated into the cellular tissue around, forming a soft bluish tumour, called a *thrombus*. The best course to adopt is to untie the bandage, and at once bind up the arm; opening a vein in the other arm if necessary. All attempts to restore the flow of blood by introducing the lancet generally fail, and as long as the bandage remains, the tumour increases. A portion of fat will sometimes plug up the external orifice, which should be removed. Great difficulty is occasionally experienced in obtaining the blood in a sufficient stream; it will sometimes escape over the arm, trickling from it into the basin. A plan sometimes adopted for making the blood flow more freely,

**Thrombus.**

is to put in action the muscles of the arm, by directing the patient to close and open the hand. Although the opening into the vein be free, direct, and of sufficient size, and the bandage be properly applied, the blood is not propelled onwards with sufficient force, and symptoms of approaching syncope usually soon become manifest.

Size of incision.

We regulate the size of the opening according to circumstances : sometimes it is desirable to produce an impression on the system at the expense of as little blood as possible, and we then draw it in a full stream. At other times it becomes necessary to remove a larger quantity, and we then endeavour to prevent syncope (which necessarily checks the current) by abstracting it more gradually. But it is always very desirable to bleed the patient either in the standing or sitting posture, avoiding the recumbent position, if possible. The occurrence of syncope during recumbency may be attended with considerable danger.

An operation often unnecessarily resorted to.

This operation is now very much less frequently resorted to than formerly, but the resort to this practice is unhappily still very frequent. I think we may form a very good idea of the manual skill of a surgeon, by observing him perform this simple, common operation. There is generally no excuse for soiling the dress or bed-clothes ; even the contact of blood with the arm may be avoided ; and if the bandage become stained, a fresh one should be employed for binding up the arm.

Abscess, phlebitis, &c.

Venæsection is seldom followed by any ill consequences; but among occasional results may be enumerated inflammation of the integuments, or subjacent cellular tissue, terminating in abscess, phlebitis, inflammation of the fascia, inflammation of the absorbents, and neuralgia from a wound of one of the branches of the cutaneous nerves.

Jugular vein.

The external jugular vein is now much less frequently opened than formerly. Children are generally the subjects of this operation, the veins at the bend of the elbow being less convenient for puncture. The opening is made in that portion of the vein which lies upon the sterno-mastoid muscle, it being here less likely to roll from under the lancet. We open the vein in a direction across the fibres of the platysma myoides, *i.e.* in the direction of the sterno-mastoid muscle. I believe more importance has been attached to this law than it really deserves; indeed, some surgeons (as the late Mr. Cooper*) recommend the incision to be made in the direction of the fibres. The vein is previously compressed above the clavicle with the thumb, which pressure is on no account to be relaxed till the wound is closed; this is effected by a pad of lint and strips of plaster. The danger of admitting air in a vein, is now well understood; and the surgeon would be highly culpable who neglected the exercise of every precaution to guard against this very serious accident.

## ARTERIOTOMY.

Oblique division.

This operation is usually performed on the temporal artery, the anterior branch being generally selected: but if that and the posterior be too small for the purpose, the trunk may be opened. The vessel is rendered steady by the thumb and fore-finger, one being placed above, and the other below the spot to be punctured. The artery is divided obliquely, to the extent of half its circumference; there is no necessity for making a preliminary incision. When sufficient blood has been drawn, it is best to complete the division of the artery, future ill consequences are thus in a great measure prevented. A firm pad is placed upon the wound, and retained by a bandage applied tightly round the head. The "nodose" bandage is sometimes employed;—a common bandage, about four yards long and an inch and a half wide, is rolled up into two heads of unequal size;—the intermediate portion is applied over the pad on the artery, and the two heads are carried horizontally round, one before and the other behind, to the opposite temple, where they are crossed and brought round to the starting point. They are then half turned or twisted on one another, and carried one over the head and the other under the chin to the opposite side; here they cross, and are continued onwards in the same course to the point of departure. These manœuvres being repeated two or three times, the long head is applied circularly, and the whole is fixed. The portion extending under the chin is often very inconvenient. The circular bandage is generally preferable. Pressure should be employed for six or seven days. If it happen that hæmorrhage is not restrained by these means, and that a false aneurism forms, the vessel must be tied above and below the wound.

---

* "Surgical Dictionary," Article, *Venesection.*

# CHAPTER XI.

## ON VARICOSE VEINS.

OCCASIONAL EXTENT OF THE DISEASE—VARIETIES OF TREATMENT—TREATMENT BY ESCHARS.

The venous system of the body and more especially the veins of the extremities are liable to swell, to elongate, to become thickened, and to assume a remarkable degree of contortion, dependent on defective action of the valves; the blood sometimes coagulates within them, and by this means one or more veins may become obliterated. In this condition they are called *varicose*. The vena saphena is the especial seat of this disease, and not infrequently the veins of the spermatic cord are affected, constituting the variety known under the name of varicocele. Occasionally we find the superficial cutaneous system of the whole body involved. The pain and sense of swelling, the occasional œdema of the extremity, and the ulceration, that so frequently attend a varicose condition of the veins of the lower extremity, render the resort to some positive treatment necessary for the comfort, as well as for the utility of the subject of them, and various have been the means resorted to by surgeons for their permanent cure. These veins are liable to rupture, and very copious hæmorrhage follows. Temporary relief from this liability and consequent ulceration is afforded by pressure, but the application of pressure is irksome and tedious; it must be frequently re-adjusted, a large proportion of the force is lost by its adaptation to a part of the surface that does not require it, and its efficacy is, after all, uncertain and very transient, notwithstanding all the care bestowed on its application.

The vena saphena.

Efficacy of pressure.

It must be acknowledged that a permanent cure of a case of extensive varicose veins is very desirable, and various have been the efforts made to accomplish it. This necessity was felt as far back as the time of Galen, who employed powerful cautery for their removal. Sir E. Home experimented a good deal in his endeavour to cure them, by means of a ligature placed around the saphena vein, both above and below the knee-joint. But this practice, adopted in various hospitals of the metropolis, proved fatal to a great number of patients, and was at length abolished.

Treatment by ligature unsuccessful.

Division.

Within the last thirty years those veins that were especially the seat of varix in the leg have been divided across by the knife, and the coagula have been removed from the interior of the vein. Sir B. Brodie adopted the expedient of passing a fine scalpel across the vein underneath the skin, and dividing the vein with as little injury to the integument covering it as possible. But under all circumstances in which the vessel was cut, the proceeding frequently failed, even the subcutaneous operation of Sir B. Brodie was unattended by success. Many cases of death followed the operation of Sir E. Home, while the partial obliteration of the disease under the improved operation did not appear to command by any means universal success. The liability of these veins, when divided, to assume an inflammatory condition, and to convey its influence to the constitution, giving rise to symptoms of a severe form of typhoid fever, which often proved fatal under the most skilful management, has attached some degree of danger to any operation adopted for the cure of varix, which requires the vessel to be divided or laid open. But no comparative danger attaches to the destruction of the saphena and its branches by means of escharotics, which may be employed in the form of caustic issues, with all confidence, for the removal of varicose veins of the leg. Having tested this practice for many years, and adopted it largely in the out-patient ward of St. Bartholomew's Hospital, and also repeatedly in private practice, I can unhesitatingly say, that the treatment is both efficient and safe.* In one or two cases the disease of the veins has partially returned at the expiration of three years, or rather a new disease has sprung up in the neighbourhood; but, generally speaking,

Occasionally fatal.

Cure by small eschars.

---

* Dr. Clay, of Manchester, informs me that I derived the knowledge of this valuable principle of treatment from him twenty years ago.

the relief has been permanent, while, with regard to the question of safety, I have never known an example of serious inflammation, or indeed the least indication of injury done to the venous system, beyond the locality destroyed. The merit of this treatment is, I conceive, due not more to the entire destruction of the trunk of the vein merely, than to the safe application of the agent employed, to any and every part in which diseased veins congregate.

Weak circulation.

In looking to the class of persons affected with this disease, we find them, almost invariably, the subject of debility; the heart beats feebly, the circulation is torpid, the extremities are cold; there is a tendency to a greater than ordinary *remora* in the venous currents, and this condition, so liable to the formation of varices in the lower extremity, is highly favourable to the production of the low typhoid fever, which accompanies inflammation of the veins. Before any local treatment be adopted, an attempt should be made to improve this state of constitution, and to promote a greater degree of vigour in the circulation. Had this principle been carried out in cases of division of the veins, it is very doubtful whether the consequences that have too frequently followed this apparently trivial operation would not have been averted.

Potash and lime.

The agent I have employed is that of powdered lime and caustic potash, mixed in the proportion of about three of the lime to two of potash, but the potash must be good and fresh. These powders are mixed and made into a paste, by the addition of alcohol at the moment of its application.

Eschars should be small.

Any number of eschars may be made on the diseased veins; I have made as many as twelve on one leg at a time, selecting for their application the most prominent parts of the disease upon which the eschar is to be made. The size of these eschars, regulated by that of the aperture made in three or four layers of good adhesive plaster, is of great moment. They cannot well be made too small. I formerly cut an opening of the size of a shilling, but this involved the surrounding skin beyond the margin of the vein, and an ulcer of unnecessary magnitude followed, that was difficult to heal; for in all these cases, consequent on the peculiarity of constitution I have alluded to, the healing action is exceedingly slow. Those that I now employ are less than a fourth part of that size, sometimes but little larger than the diameter of a split-pea, the number of which may be regulated by the extent and complication of the disease. The smallest size is sufficient at once to obliterate the vein. Whatever number be made, the entire operation should be completed at once. The region of the ancle may require two, three, or more, placed over the early branches of the vein. Four, five, or six, may be applied on the trunk of the vein up the calf, and others below the knee. I have made these eschars also above the knee, but not frequently, not because there is any danger attending it, but because the diseased condition of the vein does not often appear to require it. When the places for the application of the caustic have been selected, and the plasters firmly fixed, the ingredients of the paste should be mixed and pasted on the aperture within them. A piece of plaster should be laid over each quantity, and the whole may be removed in from twenty minutes to half an hour. It will then be found that the veins are obliterated, in fact, they have disappeared. Rest in the horizontal posture is desirable, but not essential. In the course of a week or ten days, in a moderately vigorous circulation, the eschars will separate, and the process of healing should then be vigorously pushed, by the aid of bark, wine, good diet, and the local application of adhesive plaster, and stimulants if necessary. Occasionally, the ulcers heal very torpidly, and may occupy many weeks.

Obliteration of vein immediate.

# CHAPTER XII.

## ON AMPUTATIONS.

INFREQUENT RESORT TO AMPUTATION, A TEST OF SURGICAL SUPERIORITY—DISEASE AND INJURY—DISEASES OF JOINTS—INCISIONS INTO JOINTS—GANGRENE—MALIGNANT DISEASE—HÆMORRHAGE—NECROSIS—OBSTINATE ULCERS—COMPOUND FRACTURES—NO STANDARD OF NECESSITY—IMMEDIATE AMPUTATIONS—PROSTRATION OF NERVOUS SYSTEM—PROSTRATION FROM LOSS OF BLOOD—REACTION—AMPUTATIONS ABOVE AND BELOW KNEE—VARIETIES OF AMPUTATION—DOUBLE FLAP—CIRCULAR—COMPOUND—STUMPS—DRESSING OF STUMPS—TOURNIQUET—COMMON INSTRUMENT—OBJECTIONS TO—IMPROVED INSTRUMENT—SPECIAL AMPUTATIONS.

THE term amputation in surgical language is usually applied to express the separation of any portion, or the whole of an extremity from the remainder of the body. We also speak, not incorrectly, of amputation of the penis or mammary gland. Amputation is the last resource of the surgeon, at once the shelter, and the confession of the incompetency of surgical art. The knowledge and the skill of the surgeon fail to cure a disease, and he is reduced to the necessity of removing the entire portion of the body of which it forms a part. If such a disease prove incurable in his hands, he is justified, in obedience to an imperative law of nature, which dictates the desire of prolonged life, in removing it, with a view to preserve the mutilated relic. Strange is it that this power of mutilating the human form—of incapacitating the individual for a large number of the duties of life, and of estranging him from former occupations, which in some form or other alienates him from the society, from the amusement, at least from the pursuits of his fellow-men—should be classed among the most triumphant deeds of the operating surgeon, while it practically illustrates, at the expense of his patient, the poverty and the incompetency of his art.

There is no operation in the whole range of surgery, that should claim the previous exercise of an equal amount of skill, of patience, or the decision on which, demands so large an amount of conscientiousness, as that of amputation. The most experienced are yet but students. As years roll on, crises of improvement occur in our history, which teach us that the advanced knowledge of this year would have rendered unnecessary the operation of the last. Within my own recollection, the operating theatre of St. Bartholomew's Hospital was the scene of weekly mutilations of the frame by the knife, while, at the present day, in little more than a quarter of a century, such operations are reduced to less than half of their former number. Whence this improved and improving condition of the pauper occupants of this single hospital? In the advance of scientific knowledge—in the increased power of contending against disease—in a fuller reliance on nature's power and disposition to cure it;—in other words, in a higher classed surgery; and I may add, in an advanced sympathy with the sufferings of humanity, and not the least in this category, in the newly acquired rank of a CURATIVE surgery, which has all but exploded the false eclât incidental to the functions of the operating surgeon, recklessly resorted to on all occasions having a show of reason. The most discreditable operation in surgery is an amputation. It might almost be expected that dexterity in its performance implies a frequent, and if so, an unnecessary resort to it. The important fact should be ever kept in mind, that there is no uniform standard of curative power; a limb that is amputated in one institution, is preserved in another. Experience in the treatment of disease, greater care, a patient watchfulness, a high-minded humanity, which identifies the sufferings of others with our own, these are the resources of the first-rate surgeon, and the safeguard of the patient. How often do we lose sight of the necessity of an amputation in the dexterity of its performance, and forget the suffering and deprivation of the patient in our admiration of the manipulative skill of the operator! A decision on the question of amputation of a limb in a large number of examples demands the exercise of the very highest resources of surgical skill, and there need to us no better evidence of the high standard of surgical superiority in any institution, than the infrequency of the resort to mutilation.

Less frequent resort to amputation.

Curative surgery.

There is no standard of curative power.

The operation of amputation is resorted to both in the case of injury and of disease, and in both, the removal of the limb is at the present day *comparatively* rare. The resources of an improved art are successfully applied to the treatment of *disease*, while we are taught by experience and by reason to place a fuller reliance on nature for the cure of *injury*.

Advance of knowledge yet progressive.

Let us hope that we have not reached the final goal of our improvement, but that we rather extend our confidence yet further in the resources of nature, trusting that the advancing knowledge of the present enlightened age may yet tell profitably for the unfortunate victims of diseases hitherto deemed incurable, and limit our resort to an operation, the frequency of which has ever stamped the records of barbaric surgery, and which yet exists as the opprobrium of our art. Let us not forget that the aim of surgery is to preserve, and not to destroy; and that more real superiority is exhibited in the successful application of skill that retains a limb, than in the dexterity, however great, with which it is severed from the rest of the body.

Recovery hopeless.

In order to justify an amputation, whether of a part or of the whole of a limb, the question of recovery by other means must be placed beyond all doubt. Every resource compatible with the means of the patient should have been exhausted. Should any doubt exist in the mind of the surgeon, the patient should receive the benefit of that doubt, and a consultation with one or more eminent surgeons of the neighbourhood be held, and in the case of the proposed removal of a limb, the necessity of this final crisis should be clearly established. Then, and not till then, should amputation be resorted to. Presuming that every expedient that skill can suggest has been adopted, and without success, the amputation may be performed.

Operation well-timed invaluable.

It is not intended, however, in any remarks that have been made above, to underrate the importance of this necessary operation, to which thousands are indebted for a prolonged life of active utility to their fellow-creatures, or to undervalue the dexterity of its performance; and so long as these pretensions to a superior merit follow in their legitimate position the higher attributes which should ever attach to curative power, they may be unhesitatingly acknowledged to be not only valuable, but to be indispensable to the reputation of a first-rate surgeon.

Amputations are requisite to preserve life from the consequences, both of disease and injury. Any disease that is incurable, and the presence of which in the system is a source of such evil, or discomfort, or pain, as to render the loss of the limb desirable to the patient, fully justifies the operation. It is important, however, to distinguish between the warrant of a necessity emanating from *physical*, and that from *moral* causes. The latter, known under the term amputations of expediency,—in the French school, amputations *de complaisance*,—are justly regarded with an eye of doubt and suspicion, and to be undertaken with much hesitation. (*See* Introductory Chapter.)

Operations of expediency.

Cases of disease.

Under examples of *disease*, we resort to amputations of a limb in cases of incurable disorganisations of joints, in gangrene of the extremity, in malignant growths or tumours, in copious hæmorrhage, the source of which cannot be discovered, in extensive necrosis of bone in a constitution reduced to a state of great weakness, and occasionally in incurable diseases of the skin. In fact, it is resorted to in any form of disease of the extremity, which being either very difficult or impossible to cure, draws so largely on the circulating, and hence on the nervous system, as to endanger the present or future health of the person affected.

Cases of injury.

In examples of *injury* from violence, we resort to amputations in severe compound fractures, in greatly comminuted fractures, in which the limb has been crushed under the application of a heavy weight, and in extreme cases of irreducible dislocation ; and, lastly we amputate in distortions, comprising operations of expediency.

Operation for diseased joints.

I propose to analyse these various forms of apparent warrant for amputation. First, with regard to the disease of a joint, the most important question that arises, is that of its incurability. This fact must be clearly established by incontrovertible evidence. Every means and appliance that science and art can command should have been exhausted, without permanent benefit to the affected joint. The judicious resort to absolute rest, local depletion, proportioned in quantity to the strength of the person, counter-irritation in its various forms, local vapour baths must have failed to mitigate the evil. Disease has so far triumphed, the joint is destroyed, suppuration has been established within its cavity, the ligaments have separated from the bone, the cartilage is partially or wholly absorbed, and the ends of the bone palpably grate against each other. Is this condition of the joint a warrant for its removal, without further reliance on the resources of nature? *Certainly not;* joints are especially sensitive to the consequences of injury or violence, so long as they possess and can exercise the prerogative of health. The joint destroyed by the absorption of its cartilage, and the separation of its ligaments, no longer possesses such powers, and though lost for ever as a moveable articulation, may retain a useful existence as an immoveable one. Its peculiar susceptibility being exhausted, which in health renders the exposure of its cavity at all times dangerous, the cavity, distended with puriform or whey-like fluid, should be opened by a free incision into it, and the contents evacuated. Tractability of the diseased actions will often follow this comparatively simple expedient, and the limb be saved. I have done this operation on sundry occasions with great advantage, if it be deemed advantageous to save a limb that would otherwise have been removed.*

Absorption of cartilage no warrant.

Incision into joints.

In the year 1838, the leg of a young woman was about to undergo amputation, on account of a disease of the knee-joint of many months' duration. She had suffered a good deal of pain while the diseased actions were going on in the joint, and no doubt was entertained that the cartilage was destroyed. Obscure fluctuation was felt on each side of the patella. I requested permission to take charge of the case, and passed a lancet into the joint on the inner side of the patella, through which about an ounce of whey-like fluid escaped, greatly to her relief from suffering. Within a week I made a second opening with the same result, and this I repeated six or seven times. All pain then subsided, anchylosis followed, and the girl left the hospital at the expiration of three months, with a stiff knee, but with a useful limb. The same result followed this treatment, in the case of a man I attended with Mr. Lobb, of Aldersgate Street, whose knee had been previously condemned to amputation.

Examples.

---

* See some further remarks on this subject in the chapter on Excision of Joints.

Mr. Gay has also adopted this practice with considerable success in several joints, in the knee, the ancle, and the elbow. All these cases consisted in a diseased condition of the synovial membrane, with abscess, such as, indeed, would formerly have appeared to justify the question of amputation. In each case free incisions were made into the joint with perfect success, and anchylosis was the result.

Matter penned up within a joint is a source of great irritation at all times, and although its presence would, perhaps, hardly justify the indiscriminate resort to puncture,—for I am convinced that the process of recent suppuration is by no means incompatible with perfect recovery of the articulation,—yet, in the last stage of disease, in which the joint is thoroughly disorganized, there can be no valid objection to the adoption of this treatment. It is obvious that no harm can accrue to the structure of a joint, an incision into which would be in no greater degree injurious than in any other region of the body. The size of the incision into the cavity of the joint should depend on the more or less advanced condition of the disease. In early suppuration, especially if the result of accident, or consequent on the removal of loose cartilages, of which I have seen several recent examples, a moderate sized opening would suffice.

Size of the incision into the joint.

Grating of bones does not justify amputation.

Grating of the opposite surfaces of a joint is often urged as an excuse for removing it by amputation. But the destruction of the cartilages, although one stage in the diseased actions advancing towards disorganization, is equally *to be regarded as a condition essential to recovery by anchylosis*, and if taken by itself forms no justification at all for removal, to say nothing of the possibility of the subsequent investment over the surfaces of the bone of ivory deposit, as it is called.

In recommending the frequent adoption of this practice prior to amputation for diseased joints, I am aware that I may be met by objections founded on the prevalent opinion, that the strumous affection of joints, to which the term white-swelling is absurdly applied (in deference to an antiquated pathology), is insusceptible of the adhesive action we here term anchylosis. But I am acquainted with no evidence that warrants this conclusion, supposing pains be taken to remove all sources of local irritation, and to invigorate the system; though

I do not pretend to say that such cases give equal promise of success with the former. I have unbounded faith in nature's own resources, and in her good will, to remedy the ill consequences of disease; and I have no doubt that, under circumstances not unfavourable, a sufficiently strong union by anchylosis, or by a fibrous substitute, would reward the surgeon for his experiment.

Strumous disease less promising.

With these considerations before us, coupled with the valuable alternative of either partial or entire excision of the affected joint, I may venture to conclude that the amputation of a limb for disease of a joint ought to be deemed a rare operation; and more especially so when disorganization has resulted from synovial disease.

Amputation contra-indicated in dry gangrene.

Secondly. In the case of gangrene of a limb amputation is occasionally resorted to. In the dry gangrene of old age, the early resort to removal by the knife is contra-indicated by the experience of all good surgeons. The very nature of the disease precludes the hope of recovery from the operation, if performed during the period of progressive advancement. Under these circumstances we have no alternative, but that of waiting the gradual separation of the dead parts, and then sawing through the bone, and making the best stump compatible with the difficulties of the case. Should, however, the diseased actions subside, and give place to a regenerated power in the circulating system of the extremity, indicated by a positive separation of the dead from the living parts, and by the presence of healthy granulations, there can be no objection to the resort to amputation. These objections to the operation do not, of course, apply to that form of gangrene resulting from traumatic causes, in which all the structures of the limb are involved, and in which the circulation is vigorous, and competent to the adhesive process.

May be required in traumatic gangrene.

Doubtful in malignant disease.

Thirdly. The same remarks may be made in cases of malignant disease; in many forms and localities of which, with such tenacity do they cling to a system once invaded, that a question might be raised as to their expediency, especially if evidence be found on inquiry of the existence of disease about the trunk. Unless the disease be entirely insulated by amputation at a distance above it, and often if apparently insulated, the operation will prove futile. The discovery of chloroform is perhaps its best justification.

Fourthly. Copious hæmorrhage, the sources of which cannot be discovered. This description of injury was formerly the fruitful source of amputations of a limb, which has happily been rendered a rare occurrence, consequent on a more intimate acquaintance with the relative anatomy of the arterial system. Modern surgery presents so many resources, that the highest discredit would attach to any surgeon, at all familiar with the use of the knife, who should resort to the removal of a limb, before he had explored and examined every possible source of hæmorrhage. Still we cannot contend against the evil consequences of the irregular distribution of vessels ; and should hæmorrhage continue in such a case, after the main artery of the limb were tied as closely as possible to the seat of injury, and in spite of pressure and position, then, undoubtedly, we may be justified in resorting to amputation.

Hæmorrhage rarely warrants it.

Necrosis.

Fifthly. Extensive necrosis of bone, in a greatly weakened constitution. It is not easy to imagine a case of necrosis at the present day that would justify the amputation of a limb ; because, if a patient be so greatly reduced to a condition of weakness, as to preclude the direct removal of the dead bone, *à fortiori*, he cannot be in a condition to justify amputation. The resort to amputation in case of disease of the bones has become still more rare since the introduction of chloroform, which has exercised a most beneficial influence over the treatment of this and all similar diseases. Patients formerly lay in our public hospitals for six or nine months, or longer, for the purpose of undergoing the process of removal of the dead bone by internal agency, who now, under the influence of that valuable agent, are brought at once to the operating theatre.

Obstinate ulcers always curable.

Sixthly. Ulcerations of the skin, under circumstances of peculiar obstinacy, have occasionally appeared to warrant the recourse to the amputating knife. In such cases it would, I conceive, be more consistent with scientific surgery to destroy the whole surface by escharotics, or even by the actual cautery if necessary, than to amputate the affected limb : better to expose the muscles to the chance of their consequent destruction, were that necessary, than to remove the disease by amputation of the entire limb.

Compound fracture.

Seventhly. Perhaps the most frequent warrant for the amputation of a limb is that of severe compound fracture or other form of local injury, by which its structure is so extensively torn or destroyed, or likely to be destroyed, in the necessary consequences of the injury, as to point to the great probability that the constitutional powers of the individual will fail in the contest, and death result. Under such circumstances we take off a limb. Unhappily, however, we possess no certain gauge for vital power, and we can arrive at no certain knowledge of the full extent of the injury done. Yet it must be allowed that limbs are preserved at the present day, under frightful injuries that would have been formerly amputated without a moment's hesitation. It would be needless to attempt a general rule, unless we could obtain a perfect knowledge of the extent of the injury; and this is often impossible. Scarcely any amount or form of fractured bone alone would justify the immediate resort to the knife, if taken singly, even supposing the bone fractured extensively into a large joint, for in such a case, although anchylosis of the joint would probably occur, it would prove a lesser evil than that of amputation. Superadded to a compound or comminuted fracture of bone, the injury may be rendered yet more serious by extensive laceration of the muscles.

Laceration of muscles.

In considering this latter condition, much will depend on the kind of laceration; whether the muscles are merely cut asunder, or whether contused and torn, and whether this injury involve a few only, or the majority of the muscles of the limb. Again, we must examine with great care, the condition of the vessels. Is the main trunk uninjured, we might ask, in the supposed case of fracture of the thigh? or in that of the leg, is the posterior tibial artery torn? This artery may generally be felt by careful examination behind the malleolus internus. Is the anterior tibial involved? The dorsal artery of the foot is generally perceptible. Is the limb colder than its fellow? Is the temperature considerably lower than the rest of the body? If so, probably one or more arteries are divided. What is the condition of the nerves? Does sensibility extend to the toes? If not, probably the nerve is divided also. Under such circumstances we may obtain a better ground for forming a judgment on the issue, by making slight extension of the limb, and by replacing its lacerated structures in some approach to their natural relations. If the evidence of the integrity of both artery and nerve yet fail, and the sinking temperature of the limb, and the loss of sensibility continue or increase, we have no alternative but amputation.

In extensive disorganization we amputate.

The course adopted by different practitioners depends not on any fixed and recognized data, but on the results of general observation, on the greater or less confidence reposed by the surgeon in nature's curative powers, and something, it must be confessed, on his appreciation of the value due to the integrity of the unmutilated body.

Indirect motives weigh.

Human nature is never without its weakness. The judge upon the bench has his prejudices and his leanings, for human judgment can never become perfect ; and so it must happen in the balance to be weighed by the surgeon between retention and amputation of a limb, that some grain of self may be involved. This weakness is not discreditable to the individual, but to the species. The eclat of an operation ; the natural and commendable desire to do great deeds ; the desire to avail ourselves of the opportunity of instruction to others ; or the still more commendable motive of ensuring recovery, although by a hasty sacrifice of the integrity of the frame ; these, and various other agents, are unconsciously interwoven in the decision of the surgeon, as to his conduct and management of the case. If against such influences as these, a higher standard of professional superiority were established as our guide, and a yet sterner view of the moral responsibility of our decision ; if it should ever become the boast of our profession, not that we had performed so many operations, but that we had rescued so many limbs from the knife, then it cannot be doubted that the resort to this operation would be yet more rare than it is even in the present era of enlightened surgery.

In doubt, postpone the operation.

If a doubt exist in the mind of the surgeon on the necessity of immediate amputation, there is less objection to giving the patient the chance of recovery, by postponing the operation, especially in cases of injury that admit of subsequent amputation *below* knee, than in subjecting him to the consequences of unnecessary mutilation. Death is a comparatively infrequent consequence of amputation below the knee ; while, to any ordinary mechanic, the loss of a leg is as fatal to his future employment as that of a portion of the thigh in addition. Mr. Abernethy entertained a strong objection to amputation for compound fracture in the neighbourhood of the ancle-joint. Possessing a greater than the average confidence of the profession in nature's power and goodwill to cure it, Mr. Abernethy showed his superiority, not in his own greater curative power, but in his more profound insight into, and reliance upon that of nature.

Immediate amputation.

Much has been said about the necessity of immediate amputation after compound fracture, &c. The argument for this necessity is founded on the evil of a second shock to the system. But this principle, although good in the abstract, is often greatly misapplied, and as often violated, even by what we call *immediate amputation.* The principle originated from the surgical practice of the battle-field, in which a wounded soldier is brought from the ranks and placed under the hands of the surgeon, either immediately or within a short interval of the occurrence of the wound. But the case is different, both in private and in hospital practice, in which some hours from the period of the accident may elapse before the arrival of the surgeon; and I am inclined to believe that, for the most part, the condition of a person with severe compound fracture is as favourable for amputation at the expiration of thirty-six or even forty-eight hours, as at the expiration of three or four. The principle itself is sound, if strictly obeyed; but its rigid observance is incompatible with the ordinary duties and occupations of the surgeon, whether in private or in hospital practice; and I consider that the postponement of all doubtful cases of severe injury to the issue of one or two days' experiment, is more consistent with the principles of a higher classed surgery, than the loose obedience to a law, which, however abstractedly good, is incompatible with the necessary requisitions of professional life. This argument obtains additional force, from the fact that the error, if any, is committed on the side of humanity.

Erroneous views of reaction.

With regard to the question of *reaction* after serious accidents, it appears to me that some error prevails in the professional mind. We do not sufficiently distinguish between the consequences of violence done to the circulating, and that to the nervous system. A man receives a severe blow on the abdomen or elsewhere; his nervous system sustains the first effect of the shock; his pulse sinks till it becomes almost imperceptible, but he has lost no blood. To amputate a limb which may have been fractured or crushed, or otherwise severely and hopelessly mutilated, in this condition of his system, is to hurry him on to his death. The cause is a shock which time can, and under favourable circumstances, will remedy. We give him stimulants, and his circulation rallies; his physical powers revive, and in the course of one or more hours, we amputate, and with success. Contrast this case with that of a man reduced to an equal degree of prostration by *loss of blood*, consequent on severe compound fracture or mutilation of any kind. In such a case, how can we expect reaction to take place with the circulation reduced by a large diminution from its standard quantity?

Prostration of the nervous system.

Prostration from loss of blood.

If the degree of prostration be disproportionately great to the quantity of blood lost, then it is obvious that the nervous system is also involved; and, under such circumstances, we may reasonably anticipate some attempt at reaction under stimuli, and we are justified in postponing the operation for that purpose; but if there exist good grounds for believing the hæmorrhage to have been considerable, and it is always difficult to ascertain the quantity of blood lost, we must attribute the prostration primarily to that cause, and resort to immediate amputation. The oozing of blood, in however small quantities, from the circulation of a person greatly reduced by previous loss, is to be regarded as no unimportant addition to the evil already sustained; and we shall watch in vain for any accession of vital power, so long as it continues. In a case, on the other hand, in which the bleeding has entirely ceased, it is easy to imagine that although we cannot anticipate what is strictly denominated reaction, yet, that we may rally the power that yet remains by an occasional brief postponement of the operation, and by the employment of stimuli; but to wait for a rallying circulation, such as in other circumstances would justify the resort to amputation, is to expose our patient to the increased probability of a fatal issue. The amount of blood lost may be generally guessed at by the effect of stimulants, the influence of which will suffice to obtain some reaction in a circulation reduced by the sudden loss

No rallying power after severe loss of blood.

of a smaller quantity, but which is inoperative to good, in cases in which the drain has been considerable, and continuous for some hours.

Eighthly. We may be compelled to resort to amputation in extreme cases of irreducible dislocation, but to justify the appeal to the knife, every means should have been exhausted, both ordinary and extraordinary. The failure of the usual means of extension should only dictate the resort to *unusual* means; we must sacrifice the joint for the sake of the limb, as we sacrifice the limb for the preservation of life. The joint should be carefully surveyed for the purpose of ascertaining the nature of the difficulty, and its precise locality. Anatomical knowledge of the joint is here invaluable. The cause of these difficulties in reduction usually depends on the displacement of some partly torn ligament or tendon distorted from its course during the accident, but far more generally on the former. Whatever be the obstructing agent, be it ligament, be it tendon, or be it muscle, it should be divided by means of a fine-bladed knife passed down to it. If necessary to this important object, the skin should be divided to an extent sufficient to expose the cause of obstruction, and the bone removed by the saw; but this is better avoided if possible. If this principle be fully carried out, if the surgeon resolve to sacrifice the joint, or rather to *risk* the destruction of the joint as a moveable articulation, amputation will be rarely resorted to in cases of irreducible dislocation.

Ligament to be divided.

With regard to operations for distortion &c., or operations of expediency, as they are somewhat inappropriately called, I have only to remind the reader that they are so often followed by serious, and even dangerous results, as indeed are all large operations performed during a condition of the nervous system, unprepared for the shock, that they should rarely, if ever, be recommended, and not always resorted to on importunity. (*Vide* Introductory Chapter.)

In cases of severe injury of the leg, or any other cause involving the lower extremity, it is a principle in surgery to amputate below knee if possible. This rule, which is so imperative as to give it the character and importance of a law, is founded not so much on the necessity of preserving as large a portion of the body as possible, as

Amputations below knee less dangerous.

upon the lesser danger of the latter operation. In the operation below the knee, the soft structures constitute a less proportion of the limb, and the bones the greater. The thigh is composed of large muscles, holding a more elevated position in the economy of the body, with both vessels and nerves equally important, any serious injury to which, the nervous system of a person would take more early cognizance of, than from a similar violence done to the leg below the knee. The chance of recovery, therefore, is considerably greater after amputation below, than above knee, however closely to the joint the latter operation be performed. Some ingenuity may be occasionally required in obtaining a flap sufficiently large to cover the ends of the bones; but if it cannot be obtained from one side of the limb, it may from the opposite; or, indeed, a portion may possibly be obtained from each, that will prove sufficient when united by suture; for even this proceeding, objectionable as it may appear, is a less evil than the excess of danger of an amputation above knee, over that below.

Three forms of amputation of the shaft or body of a limb are practised by British surgeons. The first of these, and that perhaps most commonly adopted, is the circular amputation. The second consists of a double flap of the soft structures passing down to the bone; the third is a modification of the two former, consisting of a flap of the integuments, and a circular division of the muscles.

Circular amputation.

The circular amputation is, or ought to be, performed in the following manner. The skin, if covered with fine hair, often found on all the extremities, should be shaved; the tourniquet applied over the main artery of the limb; the integuments should be drawn up, and held firmly by an assistant; the surgeon, standing on the right side of the body, and steadying himself with his left hand on the limb, immediately above the part to be divided, and with a view also to enable his two hands to act in harmony, and obey the occasional and uncontrollable movements of the limb, should pass the knife around the extremity to its upper surface, or beyond it, if possible, and commence his incision at the proximal end or heel of the knife, close to the handle, and carry it round the limb in an exact circle. Now, as the length of the blade is only one foot, or fourteen inches at most, and the circumference of the skin is, perhaps, sixteen or eighteen inches, the whole of this circle must be divided at one sweep of the instrument, while drawn uninterruptedly onwards, from the heel to the point. This can only be effected by applying the blade uniformly throughout its entire length, and giving to every part of it an equal proportion of the work to be done. The force of pressure employed by the hand will depend on the resistance of the parts to be divided. This will be ascertained at once by the operator. If the knife is exhausted before the circle be completed, it must be reversed, and the circle completed by dividing the remaining integument towards the operator. This first incision should reach the fascia covering the muscles, or nearly so ; part of the circle may exceed that depth, part barely reach it. This is of little real importance. The integuments and fat varying in thickness in different regions of the body, and in different individuals, from less than a quarter to more than half an inch, are to be divided, and reflected upwards all around, to the *full extent* of the semi-diameter of the limb. They may be reflected to a yet greater extent, in cases in which the fat is firm, and the integument and fat inflexible, or they will not readily adapt themselves to the surface of the bone, without more effort than is desirable. Being reflected upwards, they should be drawn and held firmly in this position by the assistant. This constitutes the entire of the first stage of the operation. The second stage consists in the complete division of the muscles, as high as possible, by a second circular sweep of the knife, which should separate them entirely down to the bone. This is effected partly by the employment of somewhat more force, and partly by address and dexterity. Care should be taken to prevent the muscles forming a fold by the general pressure of the knife before the cutting edge reaches it, or the incision of the muscles will be jagged in this part of the circle. The mass being large and even pendulous, the force required must be regulated by tact. The third stage of the operation consists in the separation of the bone or bones by the saw, a duty of some delicacy. The instrument being applied to the bone at the extremity near the handle, and the short diameter of the blade held

First stage.

Second stage.

Third stage.

vertically to the bone, is to be drawn firmly and slowly to the point and vice versâ, employing at each stroke the whole length of the instrument, and considerable force of pressure.

During this part of the operation, the soft structures require the protection of a linen retractor, drawn up over them. By this action the femur, which is the firmest bone divided in amputation, may be separated in about six double movements of the saw.

Flap operation.

The *flap* operation is performed either in the transverse, oblique, or vertical direction. It is applicable in amputation of the thigh or upper arm, and is occasionally resorted to in the fore-arm and leg, but under less advantageous circumstances.

It is a suitable operation where the bone is single, and occupies the centre of the limb, the substance of which presents a nearly equal thickness all around. It is inapplicable when we have a double bone, because that part of the limb has no centre to aim at, and the proximity of one or other of the bones to the skin renders the future investment of that bone weak and imperfect, where it ought to be especially strong and thick. For this operation a long pointed knife is used. This knife should be double-edged at the point only, the edge on the back extending to about the length of one inch along the blade. The operator, grasping as large a portion of the soft parts of the limb as possible in his left hand, with which at the same time he fixes the limb, passes the knife through its centre down to the bone. The point of the knife, still urged onwards, passes, as nearly as possible, around the bone to the opposite side, and then pursues the same course through the posterior half of the limb, emerging at a point, as nearly as can be conveniently made, opposite to that at which it entered. The knife should then be carried obliquely downwards and outwards towards the skin, through the muscles and integuments, to the extent of three to five inches below the point of its first introduction. The length of the flap is required to compensate for the future contraction both of the muscles and integuments. For this purpose a slight and slow sawing motion may be given to the instrument, if requisite to complete the incision. A similar flap is now to be made of the opposite half, corresponding in form with the first.

A small portion of muscle will almost necessarily remain on each side, and attached to the bone. This should be divided by a circular movement of the knife, and the bone sawn through as high up as possible, the soft parts being protected by the retractor.

Flap of the integuments.

The third form of operation, which is a compound of the two above described, is commenced by an incision through the integuments only, carried downwards in an arched form from the point at which it is intended to divide the bone to a corresponding point on the opposite side of the limb. This part of the operation may be performed with a large scalpel. The height of this arch should be more than equal to the semi-diameter of the limb, and when the incision is completed, the flap should be reflected upwards to a line corresponding with its base. A second incision is then to be made through the integuments of the opposite side, similar in form to the first. When sufficiently reflected, the muscles are divided in the same manner as in the circular amputation.

Motives of selection.

In the selection of the most suitable form of operation to be performed in any given case, the surgeon should keep in mind the future services, if any, to which the stump is to be applied, the duration of time required for healing the wound, the condition of the patient as regards his capability of losing blood with impunity, and the time required for the performance of the operation. The question of physical pain, and, for the most part, that of the duration of the operation, are less significant items in the consideration, since the introduction of chloroform, which, it is hardly necessary to add, should be always administered.

Future services of the stump.

With respect to the future services to which the stump may be applied, it should be recollected, that the lower extremity will be still employed as an agent of locomotion, and if the limb has been amputated above knee, the pressure of the whole body in the act of walking is thrown upon the bone, tending to force it through the integument, or whatever material covers it; whereas, in amputation of the leg below the knee, the tibia is bent at right angles, and is, in hospital cases, supported on a wooden pillar. Where an artificial foot is intended to be worn, the conditions correspond with those of amputation above knee. Also the arm is subject to no such test of the strength of the cicatrix, there being no pressure employed. Under all circumstances, the duration of the curative process is an important consideration. It is an object, therefore, to render the wound as small and as simple as possible. The same remark will apply to the loss of blood, whether during the operation or after it, and if it appear on inquiry, that in one or other of the above operations, a larger quantity of blood is lost than in the other, the fact may be fairly urged as an objection to that form. One condition is indispensable to every good stump, viz., an ample allowance of integument; integument sufficient in quanity to meet in the centre, or at the side without tension. This consideration is more important than any other in the operation. If an error be committed, let it be that of excess, not of deficiency: no merit can compensate for want of healthy integument; for integument, by which is understood the entire of the structure external to the fascia, and including the fat and cellular tissue beneath the skin, forms the only good investment for the exposed bone.

Time required for recovery.

Loss of blood.

Muscle a bad investment for bone.

It is equally a just and a general opinion, that muscular substance is not a desirable ingredient in the formation of the extremity of a stump. The nature of muscular fibre, its contractility, the certainty of its form and of its relations to the end of the bone being subject to change in the course of time, forbid our reliance upon it, however specious, and however apparently suitable may be its soft cushion-like texture for this purpose. Deprived of all antagonism, the fibres gradually contract from the end of the bone, and the more especially those which form the external layer, and have the least connection with it. But while we usually avoid the presence of muscle as an investment to the end of the bone, on which, in the case of the thigh, the weight of the body is almost entirely thrown, yet a good fleshy rotundity of the limb up to the level of the extremity is a desideratum. This form of stump is more suitable for the application of mechanical support, than is that more pointed form which the stump will gradually assume if the muscles be divided above the level of the point of division of the bone, and to which the term sugar-loaf stump is not inappropriately applied. It is better that the

Sugar-loaf stump.

weight of the body in walking should be diffused over as large a surface as possible, therefore substance is required.

So long as the question of pain formed an important subject of consideration in determining the kind of operation to be selected, that kind was *cæteris paribus* the preferable one, which was most quickly executed; for, in the calculation of the evils attendant on the removal of a limb, the after discomfort, the greater liability to loss of blood from one or other operation, and the duration of confinement were deemed to be of secondary importance. But the use of chloroform has changed the question, and dispensing with the subject of pain, we may confine ourselves to the question of secondary evils.

Real merits of the flap operation.

Of all forms of amputation the flap operation is performed with the greatest rapidity—with the greatest *éclat*. I have myself amputated both the upper arm and the thigh within half a minute. But the question to be asked is, is the flap superior to the circular operation, as regards the great consideration of the real welfare of the patient? Is his recovery more rapid? My own experience would lead me to doubt the expediency of this form, if we take into consideration all the circumstances incidental to the case. In the circular operation, the integuments and muscles are cut through vertically to the plane of the limb. Arteries, veins, and nerves share the common lot; all are divided directly across. The wound in the muscles is exactly equal to their transverse breadth. The larger arteries are tied; the lesser arteries retract within their sheaths, and cease to bleed. The integuments are brought over the cut extremities of the muscles, and unite to them and to each other by adhesion.

Demerits of the flap operation.

In the flap operation, integuments, muscles, and vessels are all divided obliquely; the arteries cannot, from this circumstance, equally retract, and a greater number of ligatures are consequently required; *the divided flap of the muscles is necessarily large*, and the two opposite surfaces meet in contact, and form a fleshy investment for the extremity of the bone. Over this mass we have an integumental covering. It is true that the flap operation insures a good stump, so far as regards form; but form is of lesser moment than is the utility of the stump hereafter, and I am much disposed to believe that, for purposes of utility, and for power of resistance against pressure, the stump made by the circular amputation will in the end be found preferable. With regard to the vessels, I have repeatedly found the most careful efforts to arrest bleeding by securing the lesser arteries, fail to accomplish the end. I have known six, eight, or twelve ligatures applied, and renewed hæmorrhage has followed within a few hours; and this not once or twice, but many times. The introduction of chloroform has deprived the flap operation of its *éclat*, and in testing its entire merits by the side of the circular form of amputation, now that the rapidity of its performance is taken out of the scale, I confess that I think they will be found incompetent to the maintenance of its former reputation.

Liability to hæmorrhage.

The remarks which I have made on this subject chiefly apply to amputations of the thigh, and, in a lesser degree, to those of the upper arm; whereas, in the case of the leg, a modification of the flap operation, and also of the fore-arm, may be adopted with advantage. But these operations will be described in their proper places.

My colleagues, Mr. Lawrence and Mr. Stanley, who had frequently adopted the flap operation, have almost entirely abandoned it. The straight line of union, formed by the cicatrix of the circular operation, forms an objection, though by no means a serious one, to that mode of amputation, the corners or ends of which project in an unsightly manner, particularly when the substance of the integuments is unusually thick; but this is not an important objection, for in the course of time the central part of the cicatrix retracts, and the extremities become soft and flaccid, and cannot interpose an obstacle to the application of the mechanical substitute for the former limb. Were this evil yet greater than it is, it may be readily avoided by that modification of the two above operations which consists in a double flap of the integuments only. This is really a good operation, and possessing many of the advantages of the other two. It obtains a good form for the stump, brings into contact two opposite surfaces for union, and by dividing the muscles in a

Double flap of integuments.

transverse direction, permits of the retraction of the lesser arteries within their sheaths. The objection which may be urged against it, is the difficulty of sufficiently exposing to the eye the entire circumference of the limb in the act of making the incisions in the integuments, whether these incisions are made transversely, vertically, or obliquely; but it possesses the great advantage of affording the larger flap to cover the larger mass of muscle, as in the case of a prominent biceps muscle of the upper arm; or, in other words, of adapting the size of the flap to that of the muscle to be covered by it. It is applicable to amputations of the fore-arm, and is almost imperatively called for in cases of diseased thickening of the integuments, which we find difficult to retract, or rather to evert.

Merits and demerits.

The number of vessels requiring ligatures in amputations varies greatly. In amputation of the thigh, from two to eight or more may be required. But whatever be the number, it is indispensable to the early and well-doing of the case, that all bleeding be stopped before the stump be finally closed. When the main arteries are tied, the tourniquet should be removed, and the bleeding of the vessels encouraged. Every surface of the divided muscles and integuments, and every fissure between them, should be carefully examined; if it be determined to bring the edges finally together on the completion of the operation, every bleeding vessel should be tied. But when the tendency to bleed from minute vessels is considerable, when we are compelled to resort to the use of the tenaculum instead of the forceps, and to tie a portion of muscle with every artery, it is often necessary to adopt the expedient of applying a mass of lint, wet or dry, to the open stump, to convey the patient to bed, and to postpone the closure of the integument until all hæmorrhage has ceased.

Care in arresting bleeding.

After a long operation, by which the patient has become a good deal exhausted, it is better to place him at rest, and to expose the stump to the contact of air for an hour or two, by which the entire arrest of the bleeding will be insured, than to persevere in the examination for bleeding vessels. The necessity which too frequently occurs of opening a stump, in consequence of hæmorrhage recurring after it has been closed, requires that the greatest

Exposure of the stump to air.

care be taken to tie every bleeding vessel before this final act be completed; and especially is this rule important, in cases in which the integuments are united by suture, the necessary re-application of which is both painful and injurious.

By some operators the suture is invariably applied as the immediate agent of union of the opposite edges of a stump; and it has great advantages. The additional pain created by their introduction, if the needle be of moderate size and in good condition, is not great, for pain itself is comparative; and in cases in which a patient may have objected to the use of chloroform, or in which its influence may have proved ineffectual, or become exhausted, the lesser pain merges in the greater. The suture is a certain agent in insuring the exact apposition of the two opposite surfaces; and this is an important consideration, and less likely to be effected with nicety by means of plaster, *if the integuments are flabby*, or have been left *in quantity disproportionately great* to the rest of the stump. Again, sutures are more easily removeable on the first or after dressing of the stump, than plaster, which requires the limb to be raised from the bed for that purpose, to the great distress and suffering of the patient.

Advantage of sutures.

Plaster sometimes preferable.

Notwithstanding these advantages, in those cases of amputation in which the integuments are well adapted to the muscles, and also to each other, and also, in which the line of junction of the integuments is made vertically, and not horizontally, so that the stump may be dressed without disturbing the limb, supposing the patient to be placed on his back, I should place my reliance on the employment of good plaster, if either agent be employed singly, the great merit of which consists in the uniform pressure it affords to the stump. By such pressure, all the parts composing it are kept in exact contact, and the liability to suppurative action prevented. Still the presence of one or two sutures in the centre of the line does not preclude the use of plaster, and the two agents may be often combined with advantage, but under all circumstances in which we feel secure on the subject of secondary hæmorrhage, moderate pressure is desirable. But such pressure is not to be obtained by means of rollers, or bandages, or applications, repeatedly doubled about the stump, imitating the duplicatures that invest an ancient mummy. The appliances should be most simple.

Hæmorrhage.

Hæmorrhage into the cavity of the stump is denoted by local pain, heat, a sense of distension, and the oozing of blood from the intervals of the sutures. As soon as this condition is observed, the sutures or plaster should be removed, the stump opened, and the evil remedied, either by applying a ligature to the vessel, if discoverable, or by exposing the stump for a time to the contact of cold air. The presence of coagula would prove fatal to union by the first intention, and would protract the patient's recovery to a period of weeks. Under any circumstances this evil should be avoided if possible.

Principle of common tourniquet bad.

A few words may be not unprofitably written on the subject of the tourniquet. The application of the principle on which the tourniquet is employed, is as old as surgery. It consists in the adoption of pressure made around the limb from which blood is flowing from the vessels containing it. Nor is the instrument now in general use one degree improved in principle upon that which is resorted to by any casual passer-by, who employs his handkerchief for that purpose, to arrest bleeding from an accidental wound, notwithstanding the discovery of the circulation by Dr. Harvey, or the more recent development of anatomical knowledge, in later times. But the same apparatus is yet generally employed, although the great discovery of the circulation of the blood proclaimed to the world the important fact that any instrument, whether a tourniquet, bandage, or gird of any kind, employed to compress the main artery of a limb, while under the operation of the knife, as effectually precludes the return towards the heart of all the blood circulating below it, as it arrests the current flowing towards the limb through the arterial channels. In fact, in the act of removing an extremity, all the blood in the venous system of the limb is necessarily sacrificed, so long as we rely on the agency of indiscriminate and universal pressure. It is an argument of little value, that which justifies the loss of the blood circulating through the extremity, as belonging to that extremity, for however indispensable may be the blood to the functions of any part, yet the blood has higher and even more important relations with the centre of the circulation than with any remote part of the body; such, indeed, as involve the maintenance of functions incidental to life itself. The common tourniquet precludes the return to the centre of any part of the venous blood circulating below it, and the loss of this blood to the heart is as important as that of arterial blood; less so to the part, but even more so to the system.

Loss of blood to be deprecated.

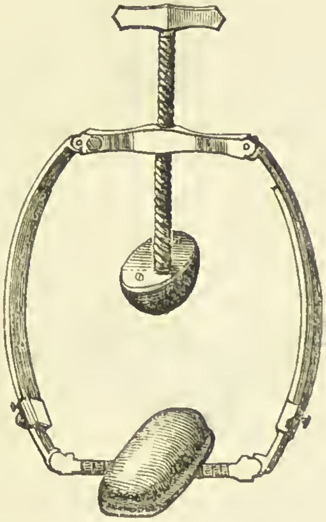
Although the loss of blood consequent on an amputation is rarely felt by the system after entire recovery, as we find by the tendency in persons who have sustained this operation to grow fat, yet the immediate consequences of loss of blood are always more or less severely felt during the period of treatment, and particularly where the hæmorrhage has been great. It is, therefore, the immediate and not the remote consequences that are to be avoided, if possible.

The Italian tourniquet.

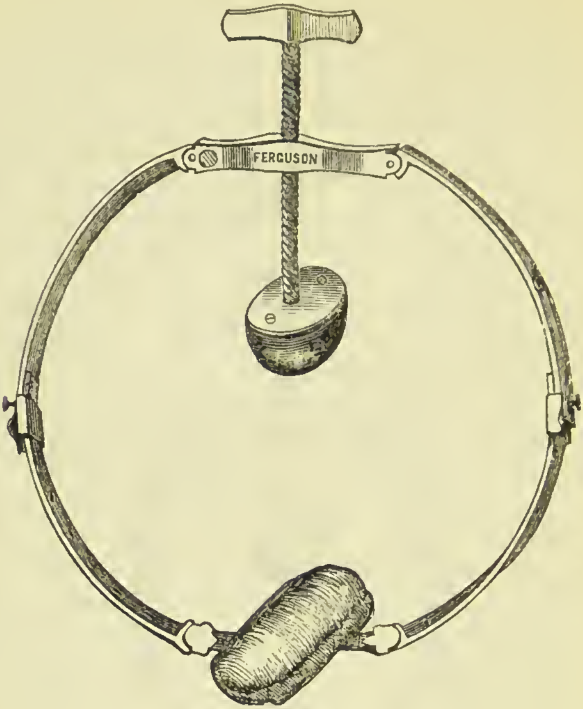
An instrument that would compress the main artery, while at the same time it would leave the bulk of the limb free to admit the return of the venous blood, has long been a desideratum in surgery, and such an instrument I have used with advantage. A considerable arrest in the direct channel of the venous circulation must necessarily take place from the proximity of the chief vein to the artery, whether in the thigh or arm; but a large part of the substance of the limb is left by this tourniquet uncompressed and free. This object has of late years been attempted in the construction of the Italian tourniquet, which has the disadvantage of insecurity, and also that it cannot be so applied as to compress the artery against the bone, by which means alone can the pressure obtain a firm base to act against.

Improved instrument.

The tourniquet which bears my name, but is the invention of my son, my house surgeon at St. Bartholomew's Hospital, is composed of two semicircles, one of which fits into the other by running in a groove. Each half is fixed by a spring catch to the other, and may be enlarged or reduced at will, to any size required for the thigh or upper arm. When required for application to the thigh, the circle, which is made to open, to admit of its application around the limb, is drawn out to its fullest size. In the centre of each semicircle is the pad for pressure and counterpressure, the former being provided with the ordinary screw. The pads are made small, in order to include as little surface in the pressure as is compatible with the safe application of the instrument. When employed for a lesser limb, the arm for example, or the thigh of a child, the circle is lessened to the required size by raising the lateral springs, and pressing the outer half or semicircle downwards upon the inner one, by which the large circle is converted into one of smaller size, the alteration being obtained by the introduction of two hinges in each half of the instrument.



I have found this tourniquet exceedingly efficient in its avoidance of the objections to that commonly used, and equally so in its power of arresting arterial hæmorrhage. It is also especially applicable to cases requiring pressure for the treatment of aneurism, being less irksome and painful to the patient when worn for a considerable time. The circulation in the main artery, which is the only one demanding compression, and for which purpose alone, indeed, the instrument is worn, is thoroughly arrested, while the collateral vessels are unaffected, and the current of blood in the venous system, except that of the chief vein, which is in close proximity with the artery, is altogether uninterrupted.



## AMPUTATION AT THE SHOULDER-JOINT.

The removal of the upper extremity at the articulation between the humerus and scapula, is happily a rare operation, and can only be justified in cases either of severe laceration of the limb, involving the structure so close to the joint as to preclude the possibility of obtaining a flap sufficiently large to cover the bone, if sawn off below the joint, or from disease, involving the humerus close to the head of that bone. This example of amputation, like that of the hip-joint, presents this peculiarity, that it possesses the material for a large flap, to cover a small exposed bone. The difficulty consists in the liability to retain too large rather than too small a flap of soft parts; but the objection to investing the socket with muscle instead of integument only does not

Muscular flap.

apply so rigidly to this form of amputation as to others; and considering that the glenoid cavity is placed posteriorly or internally with respect to the acromion, which projects beyond it, it is necessary that we avail ourselves of the muscular structure around the joint, for the purpose of a pad to fill up, in some degree, the vacant space caused by the removal of the head of the bone. Many forms of operation have been suggested and practised by various surgeons for the amputation of the upper extremity at the head of the humerus. I shall content myself, however, with the description of two only, one consisting of a single, the other of a double flap.

Pressure on subclavian.

Before operating on the shoulder-joint, the surgeon should ascertain that he has means at hand to arrest the circulation through the axillary artery and its branches. This is effected by pressure on the subclavian trunk as it passes over the first rib, above the clavicle; and as it is impossible to apply a tourniquet in this position, the charge of the artery is consigned to a competent assistant, who should ascertain, by repeated trials, that he has the power to arrest the flow of blood through the artery, both in the elevated and in the depressed position of the clavicle. As the immediate agent of pressure, Mr. Guthrie and other eminent military surgeons have employed the handle of a tourniquet, or a boot-hook well padded with lint. The pressure should be commenced at the moment arterial blood issues freely from the wound, and continued throughout the operation. The force required is not very great, even in the elevated position of the clavicle; and as the operation occupies but little time in its execution, there is no excuse for the negligent performance of this important duty. If the pressure be found sufficient, and the assistant express confidence in his power of persistent pressure, during a period of at most two or three minutes, the thumb is the best agent to be relied on, as less likely to move from its position upon the artery; and for this purpose the assistant should stand behind the patient, employing his left thumb for the right artery, letting the palm and fingers of the hand fall over the chest, and *vice versâ*.

Efficient pressure indispensable.

Various forms of this amputation have been adopted by Le Dran, Larrey, Dupuytren, Guthrie, Hennan, and Lisfranc. The merit of the operation consists, first, in the correct adaptation of the flap to the surface exposed, and, second, to its rapid performance. The more frequent plan adopted, and perhaps the most simple for a young operator, consists in making a flap of the deltoid muscle of sufficient size to cover the entire joint.

Flap of the deltoid.

The patient is seated in a chair, with his trunk supported by means of a sheet passed round the body, and fixed to the chair. If possible, his head should incline backwards on a pillow, and the position be rendered as fixed as possible, otherwise he will inevitably slide downwards while under the action of chloroform. This object will be attained by the additional support afforded by a sheet passed round the legs, and attached to the chair. The joint being carefully surveyed, the outline of a flap of sufficient dimensions should be marked upon the skin, giving a breadth above, of about four inches, and gradually diminishing below, to that of two inches. The summit of the arch should not be less than three inches and a half from the acromion process. This flap will be found sufficient to cover the exposed surface without tension.

Dimensions of flap.

The arm should be extended at nearly a right angle with the body, and firmly supported by an assistant. The deltoid and integuments should be grasped in the left hand of the operator, and an ordinary catlin, somewhat narrow in the blade, and not less than about nine inches in length, should be introduced through the centre of the muscle, forming an incision which will correspond with the line already marked on the integuments. The lower half of the incision should be first completed, and then the upper half; which is to be effected by forcing the knife more deeply towards the joint, and underneath the muscle. The joint is opened from above by an incision made into it, and the humerus should then be raised, like a lever of the first order, on the hand of the assistant, supporting it near to the axilla. This part of the operation should be well executed. This movement will tend to force the head from its socket, and to render tense the insertions of the various muscles connected to it. The operator may now, if necessary, change his position to the opposite side of the arm,

Arm forced from the socket by assistant.

and passing the catlin round the head, which is yet raised by the assistant, he cuts through all the structures below, nearly in a straight line into the axilla, leaving a lower and lesser flap, of not more than about an inch in length. In this last incision the main artery will be divided, and it must be secured immediately. Four or five ligatures will probably be required, or even more. The bleeding being fully arrested, the flaps should be united by four or five sutures, and a large mass of cotton wool applied over the entire stump, by three or four broad strips of plaster.

Double-flap operation.

The double-flap operation was first undertaken by Dupuytren, and is best executed with a short amputating knife. A line should be marked, commencing rather in front, but immediately below the acromion process, and carried downwards, inclined backwards across the posterior margin of the axilla, nearly into the centre of that cavity. The second line, commencing at the same point from which the first line arose, pursues a similar course downwards and inwards, across the inner border of the axilla, to meet, or nearly to meet, the former. These flaps should be ample, but not in excess; and when the lines are drawn, the surgeon will be able to form a tolerably correct opinion as to their sufficiency, or otherwise.

The patient should be seated on a chair, as in the former case, and his position secured by a sheet passed around his body, and either held by an assistant, or fixed to the back of the chair. The arm should be raised to nearly a right angle, and held firmly by an assistant. The operator having previously marked on the skin the lines he intends to follow, introduces the point of the knife below the acromion, and makes his posterior flap, which includes, with the integuments, nearly the entire substance of the deltoid muscle. The flap being held upwards by the surgeon, or by an assistant, the muscles inserted into the greater tubercle are rapidly divided, and the joint is opened posteriorly and superiorly. By then forcing the arm across the patient's chest, the head of the bone is thrust out of the glenoid cavity, and fully exposed to the eye. The surgeon now changing his position, if in the case of the right arm, from the outer to the inner side of the arm, passes the knife across the

Head forced out from the socket.

inner side of the head, and follows, as nearly as possible, the inner line, by dividing the flap, which is opposed to that already made; care being taken that the arm be not drawn too forcibly from the body while the last portion of this incision is being made. I am rather inclined to make this second flap from the skin inwards; partly from the occasional difficulty of passing the knife through the joint, and partly because I think a more certain measure may, by such a proceeding, be taken of the requisite flap. The axillary artery should be immediately tied. It will be found behind the coraco brachialis muscle.

Soft pressure on the joint.

Both in this and the former operation, a mass of cotton wool should be applied over the flap, when united by suture, to effect steady and uniform pressure of the flaps against the bone; and supposing all bleeding to be arrested, nothing will more fully contribute to an early and healthy cicatrization.

The above operations require comparatively little anatomical knowledge. If the incision through the integuments be correct, all that remains is the division of all the structures that surround the joint. It is a coarse operation, and does not admit of any great degree of skill or dexterity. Bold cutting is its greatest requisite.

Of these two forms of amputation at the scapulo-humeral articulation, neither is very preferable to the other. Perhaps the single flap is the simpler operation, and somewhat easier of execution. I think an objection may be urged to a single flap of magnitude, when two can be obtained to unite in the middle; for, if it be necessary to re-open the stump, we disturb the divided parts less by separating a double flap formed by two portions of the integument and muscle, than by raising up the entire single flap. I should say on the whole that the double flap operation was the preferable one, if done well, but it is rather more difficult of accomplishment; and, in either case, I may add, that it is an evil to have flaps of too great size, though, of course, not so great or unpardonable an error as to have made them insufficient to meet without tension or effort.

Avoid deficiency of flap.

## AMPUTATION OF THE HUMERUS IMMEDIATELY BELOW THE HEAD OF THE BONE.

This is a more difficult operation to execute than that of amputation at the shoulder-joint; but it possesses the advantage, when practicable, of retaining the head of the bone as a support to the deltoid muscle. By this means, the rotundity of the shoulder is in a degree preserved; but not perfectly so, because it must be recollected that the divided deltoid has a very limited function restored to it, and this muscle will gradually waste in form and substance, and display the outline of the acromion process, from which it arises. Beyond this weak argument in its favour, I am inclined to prefer the former operation. Amputation below the head requires the application of the same means of arresting the circulation by pressure of the axillary artery, unless the application of a compress of lint, placed high up in the axilla, and secured by the band of the tourniquet over the acromion, as recommended by Mr. Guthrie, in his work on Gunshot Wounds, suffice for this purpose.

**Retains the form of the shoulder.**

The patient should be seated as before; but his head and body must be well supported in the manner described in the last operation. Either a flap or circular operation may be undertaken, and of the two, the former is preferable. The arm being extended, the double flap is made with a small amputating-knife, in the same manner as in the double-flap operation upon the shoulder-joint, but with this difference, that it is made two inches lower down the arm; the knife being first introduced at that distance below the acromion, and carried round the outer side of the arm, dividing the muscles that constitute the margins of the axilla, close to their insertion. The axillary artery should be secured prior to the separation of the bone. It would be better to employ a linen retractor, for the purpose of protecting the soft parts from injury from the saw, especially if it be requisite to divide the bone very close to its head.

**Double-flap operation.**

Sutures will be required. Cotton wool in abundance, and strips of plaster, to effect sufficient pressure on the surface of the stump.

In the circular operation, the subclavian being com-

**Circular operation.**

pressed above the clavicle, the integuments may be divided, as in other operations of this kind. The line selected should be calculated by the necessities of the case. If it be intended to divide the bone immediately below the head, this circular incision should commence at a distance of four, or four inches and a half, below the acromion, and the integuments reflected upwards, including a portion of the deltoid muscle, which will give substance to the flap. In order to prevent the margins of the axillary cavity carrying the skin too widely off the bone, the arm should now be considerably depressed, the reflection of the skin completed, and the muscles divided as high as possible down to the bone; the axillary artery tied, and the bone sawn asunder; a linen retractor being employed to draw up the axillary muscles. The line of union of the flap may be determined by the selection of the moment. It is unimportant whether vertical, transverse, or oblique.

## AMPUTATION AT THE MIDDLE OF THE UPPER ARM.

In selecting the form of amputation most appropriate to this situation, it must be recollected, that the biceps muscle is usually very prominent on the inner side of the arm, and especially so in the working man. This fact is unfavourable to the flap operation, in which it is obviously desirable that the mass of muscles should be tolerably equal in substance all around the limb, but it is not an insuperable objection, and the operation is often performed with success. But unless executed with peculiar skill, and unless the flaps correspond in form with each other, and in size sufficient, and not more than sufficient, to meet in apposition over the divided bone, no object is attained by its selection; and, as a general rule, the circular operation, although requiring perhaps half a minute longer for its completion, will be found the preferable operation, as far as relates to the period of convalescence.

Unsuitable for the double flap.

Pressure on the brachial artery may be effected by the hand of an assistant, especially in an attenuated arm, or by the common tourniquet, applied as high as possible towards the axilla.

If the circular operation be adopted, the separation of the integuments should not be made too great, or the flap will be unnecessarily long; for unless the arm be very large, they may be drawn up considerably by the hand, in consequence of this loose connection to the chief muscle. If the biceps muscle be unusually large, it should be divided singly, for if included in the common division of all, it is liable to be pushed forward by the knife, and divided obliquely. By this act we simplify the division of the remaining muscles, we save the skin from liability to injury in passing the knife round the arm through the muscles, and we can divide without difficulty this prominent and insulated muscle a little higher than the rest of them.

**Biceps divided singly.**

In the flap operation, the half of the integuments that include the biceps should be somewhat longer than the opposite one, but the error of excess in quantity is, of the two, the more probable one. Instead of making the flaps by either a vertical or a transverse incision, it is preferable to make them oblique, by introducing the point of the knife, which should not be of unnecessary length, through the centre of the biceps muscle, and giving a portion of the muscle to each flap. This, of course, supposes the selection to be optional on the part of the operator; but if compulsory, in consequence of the mutilation of the parts below, any direction of the flaps will suffice, provided a sufficient quantity of integument be left to cover the exposed biceps muscle. It is desirable to divide the median nerve as high up as possible. The opposite edges may be united by two or three sutures, and by adhesive plaster.

**Division of biceps.**

**Median nerve cut short.**

## AMPUTATION AT THE ELBOW-JOINT.

This operation is effected by the formation of a single flap, obtained from the front of the fore-arm; but, as it is obvious that there is great disproportion between the thickness of the structures on the anterior and those on the posterior aspect, so some modification of the flap ordinarily made, must be resorted to. If the olecranon process of the ulna be removed, and the fact of the insertion of the triceps muscle into it forms but an indifferent reason for the employment of the saw, inasmuch as the functions of that muscle, referring solely to the fore-arm, are totally destroyed, the thickness of the mass composing the anterior flap will ill correspond with that behind, by reason of the proximity of the ulna to the skin.

Inequality of thickness of opposite sides.

Taking the breadth of the condyles for our guide, an ideal flap should be made, of sufficient dimensions to cover the broad extremity of the humerus when exposed. The arm should be held or supported nearly in the straight position of the elbow-joint, and the anterior flap cut from the front, by means of a long and strong scalpel, introduced immediately below the farther condyle, be it right or left, and carried round the arm, terminating at the condyle nearest the operator.

Increasing thickness of flap.

This flap should be made by inclining the knife in a direction *backwards*, through the fleshy substance in front of the joint, towards the summit of the coronoid process of the ulna. When completed, it will be found of *decreasing thickness from above downwards*, the margin being that of about one-third of an inch. The joint is now opened in front, the lateral ligaments divided, and the fore-arm pressed backwards with some force. The posterior division of the integument may either be made from the front or from behind. If sufficient integument have been obtained from the flap in front, that covering the olecranon may be removed with the bone, or, if necessary, it may be retained by passing a long thin-bladed scalpel from the front between it and the bone behind, and cutting downwards close to the back of the ulna. But this is a somewhat difficult process. By means of this description of flap, of which I shall speak more hereafter, the apposition of the two surfaces brought into contact will make some approach to equality in size and form. One or two sutures should be used, if the two edges fail to correspond, but I should place my reliance on plaster, and on the influence of its pressure, conveyed through the medium of cotton wool.

Equality of substance necessary.

## AMPUTATION OF THE FORE-ARM BELOW THE ELBOW-JOINT.

Retention of fore-arm.

In amputation of the fore-arm it is, I conceive, always desirable to retain as much of the arm as possible. In diseases of the wrist-joint we remove the arm immediately above it, while amputations higher up in the fore-arm are executed for the removal of disease, or required in compound fracture. Whenever the option remains to us of selecting the point for removal, we should keep in mind the agency of the muscles which severally influence its movements, always retaining, if possible, such as may be hereafter serviceable. The movements of the fore-arm are those of flexion and extension, and of rotation by the agents of pronation and supination, and all of such agents may become invaluable to the subject of amputation. The muscles concerned in the actions of flexion and extension are connected to the bones immediately below the elbow-joint. Next to these, on tracing the radius from above downwards is the lesser *supinator*, which is attached to it in about its upper third, and on this muscle we must chiefly rely for that position, because the supinating action of the biceps, although great, is confined to the attitude of *flexion* of the fore-arm. In order to retain the efficient agency of the supinator brevis it must have an antagonist, and following the line of the bone downwards, the first agent of pronation is the *pronator teres*, the insertion of which into the radius occupies as nearly as can be stated, the middle two inches in the length of the bone, or rather less. If the *pronator radii teres* can be retained rotation will be perfect, and the mutilated arm be still applied to very useful purposes in life.

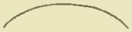
Muscular agents.

The two operations most eligible for this region are the circular and the double flap of the integuments. The objections to the common double flap are based on the proximity of the ulna to the skin on the back of the arm, which renders difficult any correspondence in form and substance between the two opposed flaps, and the impossibility of making an exact junction of each to that of the opposite half. The tourniquet should be applied on the brachial artery, half-way down the upper arm, care being taken to compress the artery upon the bone towards the

Double flap objectionable.

centre of the limb. *In the circular operation* the integuments should be reflected upwards with the knife, to the extent of about an inch or less all round the limb. The operator should be careful to effect this purpose perfectly on the posterior aspect of the arm, this part of the operation being a little more difficult. The second stage divides the muscles with a light hand down to the level of the bones, and it is completed by means of a fine catlin introduced between them, and so employed as to divide all the soft parts yet remaining. By the aid of a three-tongued linen retractor, the centre of which is passed through the interosseous space, the muscles, &c., are drawn up with some force, and the bone sawn asunder as high as possible. The bones should be sawn together while on the same plane; if posteriorly in pronation the saw will be held nearly vertically, if anteriorly, the arm will be forced back in supination. In either case the completion of the division of the radius *should be first effected*, because the ulna having the firmer connection with the elbow-joint will better bear singly the action of the saw.

Bones sawn on the same plane.

*In making the double flap of the integuments* the operator should make a careful survey of the arm, its form, thickness, &c. The flaps should be anterior and posterior. The point of division of the bones being determined on, an arched line should be drawn in front, from the central point of the radial to the ulnar aspect of the arm, and a corresponding one behind. Commencing at the starting point, the lines formed for each arch should run nearly longitudinally along the arm, to the extent of about an inch, and then curve almost suddenly inwards, passing nearly transversely across the fore-arm in this form , otherwise the arches will become pointed, and will not correspond. The depth of each flap should be about an inch, or something more. These two integumental flaps being separated up to the line forming their base, and drawn upwards with some force, even beyond it, the muscles should be divided by the circular incision, as in the former kind of operation, and the operation completed by the aid of the catlin, retractor, and saw. If this operation be well executed, the stump is in all respects excellent. The flaps are united by one or two sutures, the necessity for additional pressure by means of cotton wool depending upon the superabundance of integu-

Form of flap.

ment. In amputation of the fore-arm the radial and ulnar arteries will be found nearly in front of the corresponding bones, and of the two interossei, one upon the interosseous membrane, and the posterior half an inch behind it.

## AMPUTATION OF THE FORE-ARM WITHIN THE LOWER THIRD.

Double flap inapplicable.

The objections urged in the last subject against the double flap, apply to this locality with increased force, and the additional argument against its applicability is derived from the nature of the structures to be divided, in which tendon so largely predominates. In the attempt to divide these parts from within outwards, unless the knife be in perfect condition, and the action of the hand in cutting be exactly equal to the force requisite, so slight is the resistance to the pressure of the knife afforded by the tendons, that one or more may separate from the remainder, and be divided obliquely, or at least imperfectly; and when the tendons have been so detached and elongated, the fasciculus connected with them will not equally retract with the rest of the muscle. The consequence is that the tendons require a clean division higher up, and this new division becomes quite requisite to prevent the tendons doubling on themselves in the stump. The best operation here, also, is the flap of the integuments, which should be made in obedience to the rules laid down in the last operation; the tendons and muscles may be divided by a circular incision, or, indeed, it is preferable to divide those on each aspect of the arm singly by a straight sweep of the knife. If in this object the knife is employed with a light hand, the tendons will not be subject to dislocation, and the incision will be clean and perfect; for it is an important object to keep the tendons out of the wound if possible. The arteries to be tied will be two, three, or four in number, generally two only require ligatures.

Division of tendons difficult.

## AMPUTATION OF THE HAND AT THE WRIST-JOINT.

Rule for flaps.

This operation should be performed by means of the double flap of the integument only. The starting point consists of the styloid processes of the radius and ulna, from which an anterior and posterior flap are made, corresponding with a line in front, descending from the same process in a nearly longitudinal direction, to the extent of about three quarters of an inch, and then carried across the wrist, leaving a slightly convex edge to a corresponding point over the opposite bone. A similar flap should be made behind, and the integument reflected to the level of the articulation, which may be now opened, either in front or behind, by the division of the tendons and the carpal ligaments. In opening the joint and separating the bones, care should be taken not to expose the articular cavity between the radius and ulna, or the movements of rotation will be impaired, if not destroyed. In cases of mutilation of the hand, sufficient integument may be obtained, when necessary, from either surface of the hand, to invest the extremities of the bones. The double flap, as practised by M. Lisfranc, is, in my opinion, an objectionable operation.

Leave untouched the sacciform membrane.

Retaining carpal bones useless.

When circumstances render it necessary to remove the entire hand, there can be no advantage in retaining the carpal bones, which are insusceptible of movement on the radius, excepting through the agency of muscles, whose insertions are beyond it. There is, indeed, one exception to this fact; viz., in the flexor carpi ulnaris, inserted in the piziform bone. But this insertion into a single bone can be inoperative to good, supposing the hand to be removed at the distal surfaces of the carpal bones, and amputation at the wrist-joint has less objections than that at the latter articulation. One objection, quite worthy of notice, consists in the almost certain exposure, in the carpo-metacarpal operation, of the bursal cavity underneath the flexor-tendons. This cavity, surrounded by firm and incompressible parietes, viz., the annular ligament and the bone, which is of large size, remains patent, and may become inconvenient as a secreting surface.

Bursal cavity exposed.

In mutilations of the hand and fingers, it is often practicable to retain one or more fingers, which become hereafter incalculably valuable to the patient. When such mutilations, therefore, present themselves, and they are unhappily common enough in hospital practice, and in all manufacturing districts, the surgeon should pause, and after carefully studying the consequences of the injury, should determine on the practicability of retaining

Retain

any one or more fingers, or even a portion of a finger. It is impossible, unless under such experience as necessity alone can realise, to say to what purposes such an appendage to the hand may not be applied. It would appear that the effects of habit and education have no definite bounds, and that the resources of ingenuity, stimulated by the necessities of life, are boundless in their number and infinite in their variety; and among the occasional triumphs of the operating surgeon, there are few that more redound to the credit of his art, than that due to his skill and enterprise, in preserving unimpaired a single extremity of a mutilated hand.

every fragment of the hand.

In considering the necessities of amputation of one or more fingers, we must be influenced by the general injury sustained. A compound fracture of a single finger does not justify its removal, unless we have evidence of injury to its tendons, or to its vessels and nerves; but the same extent of injury sustained by two or more fingers may justify amputation. If the wound has extended into the palm, and torn, or otherwise disorganised the structures, or infiltrated its tissues with dirt, amputation of the distal extremity of the carpus may become necessary. If it be determined to make an effort to preserve one finger out of the four, it will not be advisable to remove the metacarpal bones at the carpal joint, but to saw them off as low down towards the fingers as is compatible with the injury done.

Preserve the thumb.

Of the five fingers, the thumb is less frequently the subject of injury, owing to its great mobility, and it is at all times an important object to preserve it; and, although, from the insulated form of its connection with the trapezium, its articulation with the carpus is not necessarily exposed to injury, yet it is safer to saw through the four metacarpal bones, if practicable, than to open the carpo-metacarpal joint.

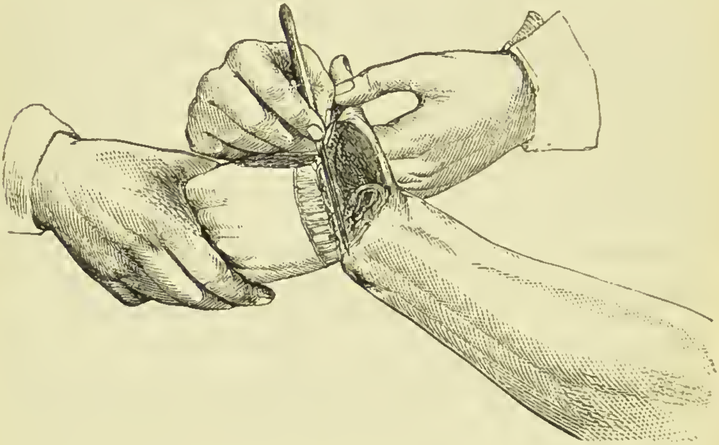
Line of carpo-metacarpal joint.

The line of this articulation may be ascertained by taking the styloid processes of the radius and ulna as our guide, which may be felt by making firm lateral pressure on the carpal joint, and from their extremities a transverse line should be drawn across the back of the hand, a finger's breadth and nearly a half below which, will correspond with the line of connection between the carpal and metacarpal bones. If the injury sustained by the metacarpal bones be so close to the articulation as to render it difficult to preserve any part of them, they had better be removed from the carpal joint.

## AMPUTATION OF ALL THE METACARPAL BONES AT THE CARPAL ARTICULATION, EXCEPT THAT OF THE THUMB.

Line for flaps.

The articulation, suppose of the left hand, determined by the above rule, being ascertained, a line is to be commenced on the ulnar side of the hand in pronation, at somewhat more than an inch below the styloid process, and continued downwards in this aspect for a full inch in length. This line, which should then be carried across the hand, in a slight curve, formed towards the roots of the fingers, should terminate opposite, about the middle of the metacarpal bone of the thumb, and at about an inch from the centre of the bone, when in abduction. From the extremity of this line, a second line should be drawn, on extending the thumb, across the fold of integument that connects it to the index finger, which should be carried round the thumb to its palmar surface, dividing this fold considerably nearer to the index than to the thumb, and continued two inches in length on this surface, parallel to, and at a distance of full one inch and three quarters from the dorsal surface of its metacarpal bone. A third line, somewhat convex from this point, should be formed across the palm to the ulnar aspect, to join the first incision.



At the radial extremity of the first of these three incisions, we must be careful not to divide the tendon of the extensor secundi internodii pollicis muscle; and at the termination of the second incision, we must be equally careful not to divide unnecessarily the upper half of the muscles constituting the ball of the thumb; this second incision should be so made as to leave ample integument to cover the metacarpal bone of the thumb. That which winds around the thumb should pass deeply through the muscles down to the metacarpal bone of the index finger. The flaps on the dorsal and palmar aspect need contain nothing but integument cut fairly down to the tendons both in front and behind. The tendons may be divided in a straight line across the joint, which should be opened on the dorsal aspect; and to effect this, the hand may be forced forwards in flexion. The order or stages of the operation should be, first, the dorsal flap made and reflected, then at once to expose the line of the articulation, and then to proceed with an incision round the thumb, and finally the palmar flap. The reason to be assigned for this order, is to enable the operator to rectify, by his final flap, any imperfection due to the first.

**Extensor tendon to be avoided.**

**Commence with the posterior flap.**

## AMPUTATION OF THE THUMB AT THE CARPUS.

The point of articulation between the metacarpal bone and the trapezium, is to be found a finger's breadth and a half below the styloid process of the radius. The line of the proposed division commences about half an inch above this joint, towards the carpus, and may be well represented by a loop of string encircling the thumb loosely, and employed for the purpose of drawing forcibly the thumb backwards in abduction. The knot of the loop will then correspond with the little fossa formed on the dorsal aspect of the thumb by the tendons of the extensor primi, and secundi internodii pollicis muscles. The thumb should be forcibly abducted, and being held in this position by the operator, a long scalpel should be passed down close along the front of the articulation of the head of the metacarpal bone with the first phalanx, commencing at the fold of the integuments. This incision should be made closely along the bone, and of about one

**Line of incision.**

inch in length. Each end of this incision should then be brought, by a gentle sweep round, to the dorsum of the bone, and approaching each other, should meet *on the metacarpal bone,* about half an inch below the joint from which the thumb is to be removed, and carried *beyond* the joint in a straight line. The extensor tendons being divided, the articulation may be opened, and the remainder of the muscles detached from the bone in bending it forwards. If the first incision be carried lower down than the length indicated before the line be inclined backwards, an insufficient covering of integument may follow.

## AMPUTATION OF THE LITTLE FINGER AT THE CARPAL JOINT.

Rule for the joint.

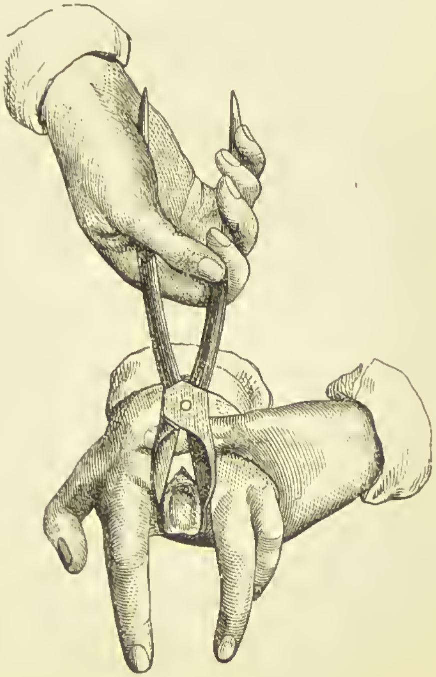
This operation corresponds very much with that of the last described. To ascertain the situation of the joint, we may take the *tubercle* on the back of the ulna as our guide, which is more prominent than the styloid process of that bone. Below the tubercle, measure one inch and a half along the direction of the little finger, and we make a sufficiently close approximation to the joint. Apply the same loop of string or flexible wire around the finger, but smaller than that applied around the thumb, so that the incision along the upper or carpal half of the metacarpal bone shall be single; in other words, the sides of the loop should gradually converge and meet about half way down the bone. For the operation the finger should be drawn inwards, and a narrow and long-bladed scalpel passed close to its inner side, along the bone, to the extent of about an inch. The ends of this incision should then be brought round with a gradual sweep on to the ulnar surface, and continued singly above the articulation. The muscles and tendons should be separated from the bone, and the articulation opened, care being taken not to injure that of the second finger, and the bone be then detached. The same operation will apply to the removal of either the index or little finger from its metacarpal bone. We should, however, recollect, that the head of the metacarpal bone is large, and requires an ample quantity of integument to cover it.

Line of incision.

## AMPUTATION OF THE SECOND OR THIRD FINGERS.

The point of articulation between the first phalanx of the fingers and their metacarpal bones, is palpable enough on the dorsal aspect of the hand. In order to find the corresponding points on the palmar surface, we may take nearly an inch along the palm for the middle and ring fingers. While amputating the fingers, we frequently remove also the head, and about one inch of the shaft of the metacarpal bone that supports it. This addition to the operation retains for the hand some approach to its original form, and removes, in some degree, the deformity incidental to the loss of a finger. But before its removal the surgeon should ascertain the nature of the pursuits of the individual, inasmuch as that the integrity of the palm may be more valuable to him than the absence of deformity. It is not suggested that the surgeon should consult with the patient on the proposed removal of the head of the metacarpal bone, but that he should simply ascertain the nature of his occupation before removing it, and form his best judgment on the expediency of doing so. This operation requires some nicety in its execution. The line of division of the parts is well defined by a loop of string, of three inches in length, when drawn tightly. To each opposite end of this loop attach a piece of string, and place the loop over the finger, drawing the ends tight on the palmar and dorsal surface, and this loop will indicate the line to be divided by the knife. The instrument employed should be a scalpel, rather narrow in the blade. While making each section with

Removal of head of metacarpal bone.



Loop of string.

Fingers drawn asunder separately.

the knife, the corresponding finger should be drawn asunder, *on one side at a time.* If the middle finger be the subject of amputation, the index should be drawn from it, and the knife introduced close to the finger to be removed, cutting down to the articulation; the blade is then to be inclined with a curve backwards, corresponding with the line of the cord, and continued for three-quarters of an inch along the centre of the metacarpal bone, and in like manner, completed in front *to the mesial line only.* The opposite section should be made in the same manner as the former, while drawing asunder the ring finger, the tendons divided high up, and the bone, when cleaned of its interossei, divided by the bone forceps, *held vertically.* Occasionally an artery may require a ligature, but not generally. A roller applied round the palm of the hand is often sufficient for the purpose of bringing the cut edges together; but if lateral pressure does not effect this important object with precision, one or two sutures on either surface may be resorted to.

## AMPUTATION OF THE FINGERS AT THE ARTICULATION OF THE PHALANGES.

Four kinds of operations are occasionally performed for this purpose. The first has the flap made from the back; the second, from the front surface; the third, takes a flap from both, and the fourth is made with lateral flaps.

Dorsal flap.

If a flap be made from the dorsal surface of the phalanx to be removed, it should be ample in size, for the exposed head of the bone is larger than it appears. The point of a scalpel is introduced down to the bone, beginning at the middle of the lateral aspect of the finger, and carried downwards, first, longitudinally, and then almost transversely, nearly as low as half way down the phalanx. This flap is to be reflected up to the joint. The finger is then bent, and the joint opened, the lateral ligament divided, and the knife passed straight through the opposite skin, the posterior flap being sufficiently long to cover the end of the bone.

Palmar flap.

The second operation is executed by passing a thin-bladed knife straight through the joint from behind while in a state of flexion. As soon as this can be effected, the edge of the knife is turned forwards and carried along the front surface of the bone, to the extent of three-quarters of an inch, when the edge is again turned downwards, and cuts its way out. This is the most rapidly executed operation of the four, but is rather more difficult of performance in this manner than either of the others.

The flap to be cut first.

This operation may, however, be executed with far greater facility by making the flap before the cavity of the joint is opened. For this purpose the finger should be extended, and the blade of the knife introduced across the finger, close below the bones constituting the joint, and carried forwards to the extent of three-quarters of an inch in a large male hand, and then passed through the skin. The finger being now bent, the joint is opened behind, and the operation completed by a few movements of the knife. Ten seconds will suffice for its completion.

Double flap.

The third operation consists of an anterior and posterior flap. These flaps should each be formed before the joint is opened, and be made of sufficient size to meet in the centre of the head of the phalanx, and both should be made from the skin inwards, instead of cutting out, as in the last operation.

The same remarks apply to the operation with lateral flaps.

In removing the last phalanges of the fingers, the second plan of operation becomes imperative, from the proximity of the nail.

## AMPUTATION AT THE HIP-JOINT.

Generally fatal.

This operation comprises perhaps the largest and the most dangerous effort made by the surgeon for the preservation of human life, and among the most advanced steps in the onward march of human daring. Although amputation at the hip-joint is an operation of which the fatal result largely predominates over success, yet cases occur on the field of battle, and occasionally in hospital practice, in which the experiment is a justifiable, and almost a compulsory one on the part of the surgeon. The warrant for the resort to this frightful alternative is found in such disorganisation or destruction of the limb, to within a few inches of the joint, as precludes the possibility of amputation below it.

In no other part of the human body in which amptation is performed, is it so indispensable that the necessities of the case be clearly established, for this is not a question of *mutilation*, but a question of *death*, and the life of the subject probably hangs on the decision of the surgeon. Two points of consideration should occupy his mind; first, the necessity of the operation; and, secondly, the mode of its performance, on which latter question, I conceive, the probability of failure or success will greatly turn. What are the necessities of the case? What extent of injury will justify the resort to it? Certainly, nothing short of such destruction of parts as will, in all professional and scientific probability, lead to the death of the individual without it. Severe compound fracture actually involving the head of the bone or the acetabulum. Comminuted fracture of the bone by a musket-ball, extending up to the joint, coupled with extensive injury to the muscles and integuments below it; large bony tumours, or incurable disease of the femur. It is, indeed, the last resource of the surgeon. Anatomical knowledge of the joint and its appurtenances is indispensable to a sound opinion, as it is equally indispensable to the proper performance of the operation by the surgeon. He should fix his attention on the situation and relations of the head of the bone, and all the salient processes around it; he should study the component structure of the material about to form the investing covering to the exposed pelvis. Possibly, on more careful inquiry, it may appear that amputation below the trochanter will answer every purpose, and an operation of less danger may be substituted.

Cases demanding it.

Knowledge of relative anatomy of the joint.

But modern surgery has many resources short of the removal of the entire limb at the joint, for diseases which at an earlier date were supposed to justify it; and it is rarely, except in cases of extreme injury from violence, that it can be justifiable. Whenever, then, we hear of the frequent resort to amputation at the hip-joint by any individual, we may ask, without suspicion of a wrong intention on his part, whether all the alternatives to such an operation were exhausted before the resort to it was made.

Frequent resort to it, infers error.

This operation, which is of French design, although first executed in England, like that of all the larger joints, requires for its efficient performance not less than two operators, for the duty of the assistant is so important, and so indispensable, as to place his functions almost on a par with those of the principal. It is his duty not simply to hold the limb, but to employ its various movements of rotation, abduction, &c., to the end of determining the direction and the extent of the incisions. He has the power in his hands of usefully promoting, and equally of thwarting the designs of the principal, and an entire unanimity should prevail between them, the result of previous agreement. In all the varieties of the operation, the circulation through the external iliac artery is arrested by pressure against the bone by means of a large compress of lint upon which the closed fist of a strong assistant should be pressed with considerable force.

Two operators required.

Pressure on iliac artery.

The compress should be, at least, as large as the body of a lumbar vertebra, and if wetted, will be less liable to slip. The larger this compress and the more general and obtuse the pressure, the higher can it be applied on the artery. The weight of the body should be employed in compression, and not the muscular agents of the arm alone. There is no necessity for active pressure until the muscles are divided.

The operation which has been commonly resorted to by surgeons, both civil and military, is that of the double flap. Success has attended them in the proportion of about one, in four or five cases. This fatality is not explained by reference alone to the formidable character of the injuries received, because it has been equally great in the deliberate amputations of the limb for chronic disease. It owes this fatality to its magnitude, to the enormous exposure of surface, coupled with loss of blood inevitable to the division of so many and so large vessels; for this loss, although not necessarily great compared to the bulk of the limb removed, is positively so when superadded to the shock on the nervous system, incidental to the separation of so large a portion of the frame from the remainder. The evil of this large exposure of surface can best be met by the circular division of the muscles, and I entirely concur in the opinion of many authorities of the highest eminence in this country, that under all

Cause of fatality.

Circular division of muscles.

permissible circumstances the flap operation should be entirely superseded by the circular one, so far as relates to the muscles; I mean, whenever permissible by the condition of the structures around, and mutilation in most shapes will more generally militate against the flap than against the circular operation. The flap operation of the integuments with the circular division of the muscle, is, in my opinion, the most suitable operation for the hip-joint, ensuring a sufficient amount of integument obtainable from any part of the circumference of the thigh, supposing partial mutilation to have occurred, exposing the smallest possible surface of the muscular system, while it guards against excessive hæmorrhage by the transverse division of the large vessels that supply the limb. But it is impossible to lay down rules that shall not be subject to numerous exceptions. The most apparently suitable operation when performed on the dead subject, may prove the least applicable in any given case. Any form of operation may become imperative for the occasion, the double flap in all its varieties of relation to the aspect of the limb, the circular, or the composite, or flap of the integuments.

The depth of the joint, and the complete muscular investment of the bone, will, at all times, attach some uncertainty to the extent of the injury sustained by the bone, supposing it fractured. The injured parts may, probably, be entirely got away by sawing the shaft of the bone below the trochanter minor, instead of removing the head from the socket, and it is a desirable proceeding, if practicable. *Cœteris paribus*, the removal of the shaft below the trochanter minor, is preferable to excision of the head; but much consideration is due to the difficulty of effecting this separation, and to the time occupied in the undertaking, the difficulty of applying the saw without injury to the already divided parts, and which, if applied, must add something to the time already occupied in the operation. Larrey, Velpeau, and other authorities chiefly of the French school, are unfavourable to this attempt. I consider it a desirable end to achieve, if practicable; but it should be fully understood to require a previous design, because the flaps that would be suitable to amputation at the joint, would be insufficient for this latter operation.

Amputation below trochanter preferable.

A few words on the anatomy of the articulation may be useful. The head of the femur revolves in the acetabulum immediately below Poupart's ligament, nearly at its centre. The position of the head is perceptible on pressure of the fingers during rotation of the limb, at a distance of less than an inch beneath the skin. From the head of the bone, the neck, an inch and a half in length, extends downwards and outwards to the shaft, at an angle of 135°, or a right angle and half. The shaft is continued upwards in a straight direction, to the extent of above an inch, to form the trochanter major covered superiorly on its outer surface by the integument only. The trochanter major extends upwards nearly to the level of the head. The trochanter minor lies behind the inner side of the neck, two inches lower down the thigh than the middle of a line drawn transversely from the trochanter major to the centre of the head. The salient points of the pelvis may be distinctly felt, viz., the anterior superior, and inferior spines, the spine of the pubes, and tuberosity of the ischium. The joint is invested in front by the psoas and iliacus muscles. The fleshy mass on the inner side, is formed by the pectinæus, three adductors, and gracilis, on the outer side by the three glutei, and behind by the flexors of the leg, semitendinosus, &c., and by numerous smaller muscles, applied closely on the back of the joint, performing the office of rotators outwards. The tuber ischii projects inferiorly nearly three inches lower down the limb than the spine of the pubes in front. The obturator or thyroid foramen, therefore, in the horizontal position of the body, looks upwards, and the knife of the operator of the double flap, may enter it without difficulty. The head and neck are surrounded by a strong fibrous capsule, and the head is further connected to the cavity; the *ligamentum teres*, attached around the notch, extending to its base.

Relation of trochanters to skin.

Relation of muscles.

The femoral artery takes a straight direction downwards, over the inner third of the head of the bone, and at the point of its division by the knife, is placed about an inch to the inner side of the shaft of the bone.

Femoral artery.

M. Larrey tied the femoral artery before proceeding to amputate. This proceeding is justly objected to by all reflecting surgeons, among whom the name of Abernethy stands prominent.

*Double Flap Operation, by Larrey.*—The patient is placed horizontally at the bottom of a bed or table, of a convenient height. As already stated, the femoral artery is first tied above the origin of the profunda. A long straight-pointed knife is plunged vertically through the thigh, close to the inside of the neck of the bone, and carried downwards along the bone, and then through the muscles and integuments, to the surface. This inner flap contains the femoral artery and vein. The flap being raised by an assistant, the joint is to be exposed and opened, and the ligamentum teres cut asunder. The head being dislocated, the knife is again introduced along the outer edge of the acetabulum, and the second flap made by cutting downwards and outwards, between the trochanter major and the skin. This part of the operation will be much facilitated by the thigh being greatly abducted by the assistant, who at the same time forces the head and trochanter from the outer skin. The flaps should not be too large.

Great abduction required.

*The same Operation by Lisfranc.*—This dexterous operator introduces the knife, which is straight and narrow, about an inch below the anterior superior spine of the ilium, which passing close to the head of the femur, reappears through the limb, a little below and on the outer side of the tuber ischii. He thus cuts the flap from the outer side, passing the knife around the trochanter, from which he separates the integuments. Then, grasping the mass of muscle on the inner side, he again introduces the knife in front, and passing it close to the neck of the bone, the handle sloping a little backwards towards the abdomen, to avoid the obturator foramen, he carries it through the limb to the point of termination of the first incision. He then divides along the bone to the extent of two inches, or more, and cuts through the mass to the skin. If practicable, the fingers of an assistant should follow this incision as quickly as possible, to compress the femoral artery before it is divided. The joint is then opened on the inner side, the limb being abducted, and the remaining soft parts divided. The line of junction of these flaps will be oblique, from above downwards and inwards.

Artery compressed on division.

Mr. Guthrie's operation is, I conceive, a great improvement on both the methods above described, for reasons I have already stated, while on the subject of flap operations in general; viz. the difficulty of calculating with precision the necessary size of the flaps, when made by incision from within outwards. In order to obtain exactness of quantity in these flaps great experience is required; and few men possess this experience, or, it is to be hoped for the cause of scientific surgery, are likely to obtain it.

It may be well to remind young operators, that in estimating the relative merit of an operation, that of rapidity of execution falls far short of the greater merit of safety; and the question of safety can only be determined by the more frequent recovery from one form, than of that from another form of operation. To adopt an operation merely because it is executed with *éclat*, is to sacrifice the interest of our patient to an ungenerous and very morbid love of notoriety. Delicacy of manipulation takes the lead of rapidity, in actual merit. Rapidity in the performance of the flap operation, one of its greatest merits, requires a knife of peculiar make, which does not form a part of the material of every amputating case.

Rapidity without neatness.

The size and form of a flap can be far better determined by an incision commencing in the skin and carried downwards, than by one made in the opposite direction, viz., by transfixing the limb; and hence the improvement of Mr. Guthrie's operation for amputation of the femur at the hip-joint, the result of great military experience on the field of battle. This operation consists of two flaps made through the skin, commencing four fingers breadth, in a direct line, below the superior spine of the ilium; and continuing each round to a point below, and equally distant from the tuber ischii. The integuments having retracted, the muscles are divided obliquely upwards to the joint, which is opened, as in the former operations.

Flap from without inwards.

A pleasing variety of about eighteen operations for removal of the femur at the hip-joint have been practised; but I shall quote one more only, which appears less objectionable, looking to the result, although less brilliant in the execution, than the double flap.

Mr. Abernethy's operation consisted in a circular incision of both integuments and muscles, made consecutively to each other, as in ordinary amputations. The circular flap of the integuments in this region does not form so good a stump as may be insured by a double flap of the integuments only; but the merit of this kind of operation consists, not in the division of the integuments, but in that of the muscles.

*Operation by Flap of the Integuments, and Circular Division of the Muscles.*—The body of the patient, as in every form of this operation, should be placed horizontally, and be well and sufficiently drawn down to the bottom of the table, to free the limb in all its movements. The limb is to be consigned to the charge of an intelligent assistant, whose actions will respond to every indication of the principal. The femoral, or rather the external iliac artery, should be kept under firm pressure against the bone by the means already described.

Form of pressure on artery.

The dimensions of the limb should be measured. The circumference of a well-sized thigh is about twenty inches, and its diameter therefore about seven. The flaps from the centre of their arch to their base should therefore be full three inches and a half to four inches in length; but it should be recollected that they have no projecting central bone to invest, but rather that of a flat surface, and also that the circumference of the limb is not circular, but irregular in form, being flat in front and projecting farther from the centre in some parts than in others. The flaps, therefore, should not be made too arched, and no integument should be wasted at their angles or points of junction. Their proposed line should be well calculated before the operation is begun. The instrument employed should be a common strong amputating knife of the largest size, turned up at the end, and sharp to the point. The first flap may be commenced about one inch below the anterior superior spine of the ilium, and carried straight down for about an inch and a half, and then inclined inwards, nearly following the line of Poupart's ligament, and about four inches below it. Reaching the adductor longus muscle, descending from the os pubis, it should be carried round in a gentle curve to a point about two inches below the tuber ischii. The second or outer flap should cross the shaft of the femur immediately below the trochanter major, and run almost circu-

Form of the limb.

Form and size of flaps.

larly backwards to the same point as the former. The flaps being reflected high, the muscles may be divided by a circular sweep, applied with great force of pressure, commencing with the adductors on the inner side, keeping the knife close to the bone, both at *their* origin, and also on the division of the flexors of the leg arising from the tuber ischii. The circle should be completed in front, when the femoral artery will be divided, and should be immediately tied, if the pressure by the assistant fail to arrest the hæmorrhage. In dividing the muscles, the limb should be made to follow the application of the knife to each surface, abduced in division of the muscles of the inner side, elevated for the flexor behind, and adduced for the glutei. The capsule being bared should be divided in front, the head disarticulated, and the ligamentum teres cut asunder, during powerful abduction by the assistant, and the arteries tied *to the smallest size.* Besides the femoral artery, three or four vessels of magnitude will require ligatures, viz., the obturator, the ischiatic, and probably the external and internal circumflex. The line of junction of the wound will be nearly vertical, or rather obliquely inwards. The flaps may be united by the compound agency of sutures, of which three or four may be employed, and of plaster, and over these a *large* compress of cotton wool should be applied, by means of a roller carried round the body. It would be well to leave the last inch of the wound open for the escape of secretions from the cavity, to be covered for the time by simple dressing.

**Requisite movements of the limb.**

This form of operation is less rapid, and therefore less striking than the double flap ; but it has one great compensating merit, it is safer, and is in reality more brilliant, if such a term be ever admissible. The difficulty of disarticulating the head of the bone, after sawing through to the shaft, is much increased, if the neck be broken. Indeed, it is almost impossible, under such circumstances, to apply the saw. In such cases we have no alternative, but that of removing the entire bone at once.

## AMPUTATION BELOW THE TROCHANTER MINOR.

In this operation the same proceeding in reference to the soft parts should be adopted as in the last operation, modified by the circumstance of an increased length of about two inches and a half. The same duty will devolve on the two principal assistants, one in compressing the artery underneath Poupart's ligament, and the other in regulating the movements of the limb during the division of the muscles. The flaps being now required to meet at a projecting centre, formed by the bone, should be made a little more conical. The muscles being completely divided, a linen retractor will be required, and should be applied deliberately and carefully over the muscles. The division of the femoral artery will be made *below* the origin of the profunda, which will require at least one, and possibly more additional ligatures in this part of the stump.

Flaps more conical.

## AMPUTATION OF THE THIGH.

Danger increasing from below upwards.

It is desirable, in amputating the thigh, to save as large a portion of the limb as possible. Every additional inch of bone is valuable. But it is not only in relation to the utility of the limb hereafter that this law is imperative, but it owes its existence to the fact that every additional inch of bone removed above the knee, increases the danger of a fatal termination. Almost as critical a question as that of amputation above or below knee, is that which applies to the part of the thigh selected for division. The evidence of recovery from amputation above and below knee, is so conclusive in favour of the latter expedient, that it should always be resorted to, if practicable ; while, with regard to the thigh, we have the additional motive which applies to the future utility of the limb. To understand this principle, we have but to observe the different gait of a person whose thigh has been amputated immediately above the knee, and who has retained at least three fourths of the bone, and that of another, in whom amputation has been performed at the middle or junction of the upper with the middle third.

Movements

We cannot but be struck with the easy natural movements of the one, when contrasted with the lateral writhings and contorted efforts at progression employed by the other. It has been deemed sufficient for the purpose of carrying the thigh forwards in the act of stepping, that the psoas and iliacus muscles, as the agents of extending the limb forwards, should be alone retained; but this general opinion is an erroneous one, *these* muscles not being even concerned in that movement. The act of flexion of the thigh is effected solely by the rectus femoris, of which as large a portion as possible should be preserved to continue its former function. The division of the muscle does not preclude the retention of its office. It acquires a sufficient adhesion to the material of the stump to answer every useful purpose, as an agent of flexion of the thigh on the pelvis, although that of extension of the leg be destroyed. In the act of walking, the thigh-bone forms the radius of a circle, and the longer the radius, the longer the step taken in progression, the more equal the movements of the two limbs; and, finally, the longer the portion of the thigh retained, the greater the facilities of applying the material for artificial support. It is very true that it is of no moment whether the radius consists of a living thigh and leg, or of dead wood or other material; but it is of every import that the rectus muscle, which is the sole agent by which the leg is put forwards in stepping, in what is called flexion of the thigh, should be retained of as great length as possible, that its action may be free, and sufficient to the required purpose. It is surprising that a surgeon of the eminence of the late Mr. Liston should have counselled the necessity of not sawing the bone below its middle, "because a long stump is inconvenient to a person in any walk of life."

dependent on length.

Action of rectus.

The thigh is, perhaps, more frequently amputated for disease of the knee-joint than from any other cause; and it should be removed immediately above the joint. Either of the three operations may be adopted. The bone is well invested by muscle in its whole extent, and the opposite flaps, be they transverse or vertical, will sufficiently well correspond in size and form with each other. Experience appears rather to favour the transverse, in preference to the vertical flap.

Either operation applicable.

As I have before remarked, the evil of amputating, by transfixing the limb by double flap, consists in the excess of soft material left, and that of the wrong kind. If the quantity and size of the flap be sufficient, and not more than sufficient, this operation loses much of its objections, but in this lies the difficulty.

Different conditions of thigh.

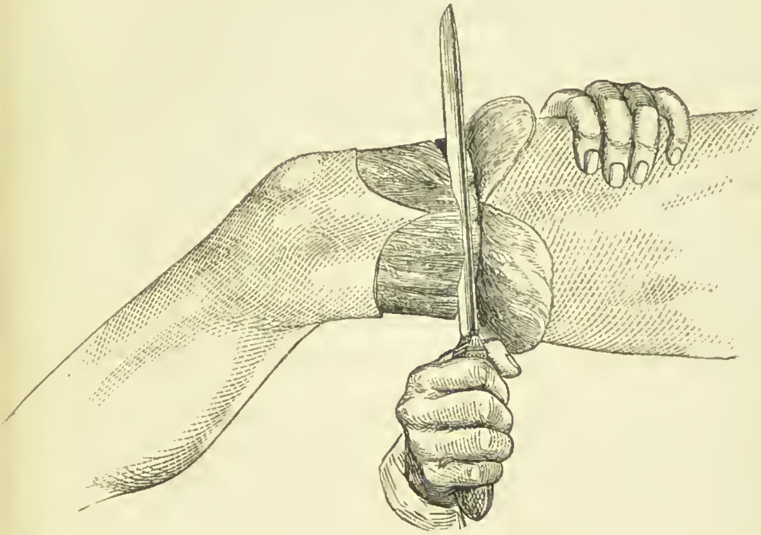
In the double flap, formed by transfixion, careful observation of the limb should be previously made, and equally careful observation of its condition, whether of firmness or of relaxation. No two structures can more largely differ than that of the thigh, which is usually firm, hard, and tight, as observed in a healthy condition of the system when amputation is required for compound fracture, and that of softness, relaxation, and tenuity, caused by the wasting of the muscles, which it exhibits after protracted disease. In the former condition of health, I conceive the circular amputation of the muscles to be most suitable to the formation of a good and efficient stump, while for the latter, the double flap is more appropriate. Whether the circular amputation of the muscles be preceded by the circular division, or by a double flap of the integument, is a question of less importance, but, as a general rule, I prefer the latter, which seems to combine, in a great measure, the advantages both of the circular and flap operation by transfixion. In transfixing the limb, whether by transverse or by vertical incision, sufficient material should be left to cover the bones and to meet easily and without tension, more than this is an evil to be avoided, for reasons already given. In a healthy limb of eighteen or nineteen inches in circumference, the flaps should not greatly exceed its semidiameter, and the knife should be brought out, allowing for the retraction of the soft parts when divided, at about four inches from the base of the arch, along the line at which it was introduced. The soft parts should be drawn up by means of a linen retractor, and the bone sawn as high as possible, especially when the muscles are large.

Flaps should not exceed semidiameter.

In the performance of this operation, the great inequality to which the upper and lower flaps will be liable, may be prevented by giving support to the back of the thigh by the hand of an assistant, during the first introduction of tho knife, and the formation of the anterior flap. Under any circumstances of direction, whether by vertical or transverse flap, it is desirable to give such support to the soft structures as to place the bone as much as possible in the centre of the limb, and to give equality to the opposing flaps.

Soft structures to be supported.

The flap operation should be performed with a long, pointed, but narrow knife, double-edged at the point only. The circular operation requires a common amputating knife of the largest size, straight in the blade, with its cutting edge turned up to the point, and also slightly at the handle, if the breadth of the blade exceed that of the handle, in order that the extremities of the instrument may be applied to the surface on the principle of the saw, and not of the wedge. Of these operations I prefer *the double flap of the integuments, and the circular division of the muscles.* The breadth of the limb should be calculated, allowance being made for the elastic recoil of the integuments when divided. The flaps *should be sufficient, and not more than sufficient,* to meet without effort. They should correspond in size, and not be made too arched. In dividing the muscles, the knife, unless the thigh be of unusual dimensions, should be carried down to the bone at once, and this can only be effected by the application of considerable force, great care being taken that the muscular mass behind the bone be not



pushed before the knife, but divided without displacement from its natural relations to the parts around. When the thigh is very large, the looser muscles, such as the rectus sartorius in front, the biceps, semitendinosus, and semimembranosus behind, may be divided separately, and allowed to retract, before the division of the remaining muscles which are attached to the bone. But this proceeding is not very easy of execution, nor would it be possible to effect it without considerable loss of time; and although it might improve the form of the stump to the eye, I doubt whether by its means a better support could be given to the weight of the body when thrown upon it; all the arteries should be carefully secured, and more particularly so in the flap operation, where secondary bleeding requires the entire material of the stump to be displaced, for the purpose of discovering the bleeding vessel. In either operation sutures are advisable, and are imperative in the double flap, and especially so if the flaps be left of unnecessary length. The remaining part of the opposite surfaces should be carefully adjusted by means of good plaster, and sufficient pressure be made, when the stump is flabby, to ensure the absence of a cavity within. To prevent the consequent pain on dressing the limb, from this too frequent cause of suffering, it would be well to have the male thigh shaved before amputation. The patient should be placed on his back, and the stump slightly raised on a pillow.

Careful arrest of hæmorrhage.

Single incision down to bone.

One other operation is worthy of mention, which consists in the division of all the textures of the thigh, by one single circular incision made down to the bone. It is an old operation revived by Dupuytren, and is applicable to the upper arm or thigh, when greatly reduced by disease. Under these circumstances sufficient integument will be left to invest the muscles and the bone, provided the assistant draw the integument up with some force before the incision be made. I have adopted it on many occasions. The bone should be sawn as high as possible.

The operation of amputation at the knee-joint is a relic of ancient surgery, and is very properly discarded in modern times, as answering no good purpose, tantamount to its danger.

## ON AMPUTATION OF THE LEG.

Operation selected, dependent on position in life.

Before proceeding to amputate the leg, it behoves the surgeon to ascertain the position of life of his patient, his occupation, and means of resorting to such form of artificial support as mechanical ingenuity has devised, as a substitute for the extremity removed. This substitute may consist in the ordinary wooden leg, or in an artificial imitation of the former foot. For either of such kinds of support, the stump and length of the limb must be previously rendered suitable. If it be intended that an artificial foot be used, the leg should be amputated as low as possible, and the removal of the diseased or injured part only, is all that is justifiable; while, on the other hand, such a length of leg would be very unsuitable, and really inconvenient to a person whose means in after life could provide no substitute but that of the common wooden leg. In the latter case, we amputate from four to five inches below the knee-joint, being content to retain just so much of the tibia as will rest, in flexion of the knee, in a direct line with the condyles of the femur, on a cushion of soft material; beyond this the projecting leg is an evil, being exceedingly inconvenient on account of its length, a useless appendage to the rest of the body, and holding a kind of sinecure on the general system, retaining all its organisation, and claiming its support, but contributing nothing to the common weal by its labour or exertion.

Action of the muscles retained.

By amputating at this distance below the knee-joint, we retain all the agents of flexion and extension of the joint; but all are not equally serviceable, whatever a superficial glance at their respective functions might determine. In front of the knee we have the rectus, no longer useful as an agent of extension of the leg on the thigh, restricted to the act of extending the limb forwards in progression; whereas, the remaining agents of extension of the leg, viz., the cruræus and vasti, have no office assigned to them, in consequence of the permanent flexion of the knee; on the other hand, the flexors of the leg are paralyzed from the same cause; and even the secondary action of the biceps, semitendinosus, and semimembranosus,—that of supporting the trunk in the attitude of stooping,—is rendered almost nugatory by the substitution of a small rounded pillar for the extended foot. Although the action of a muscle may refer proximately to the movements of the joint below which it obtains its insertion, its remote action may be subservient to distant parts. The condition of all these muscles in the neighbourhood of the knee-joint, is changed in cases of amputation above the ancle, where an artificial foot supplies the place of that removed; or, in other words, they retain their original functions, the majority of them in power, if not in number, influencing the movements of the thigh on the pelvis, in addition to that of the leg on the thigh.

Disproportion of muscle to bone.

*On Amputation in the middle of the Calf of the Leg.*—No part of the body exhibits so great a disproportion between the muscular substance of its opposite sides, as this; and, consequently, no ordinary operation will include all the requisitions of a perfectly formed stump. Of the two bones, the larger, or tibia, occupies the anterior aspect of the limb, and is covered on one of its largest surfaces by skin only, along its whole extent, while the fibula is tolerably well invested by the muscles arising from it. In the circular operation, sufficient integument can be obtained to cover both the bones and the great muscle of the calf. But should the calf of the leg be large, a huge fleshy mass is left by the divided muscles behind the bone, extremely unsightly, and not very readily healed, by reason of the dragging of the pendulous muscles, which are only partially connected to the bone in front. This, however, is the greatest, though not the only evil of this operation, and should not be urged beyond the bounds of a moderate objection, inasmuch as that the end of the stump, when amputation takes place high up in the limb, will probably not be required for support, as in the case of the thigh; and, secondly, that nature will round the stump eventually by the absorption of the useless muscles behind. The objections to the circular amputation of the leg at the calf, are, therefore, not very great.

*Circular Amputation.*—The tourniquet may be applied on the femoral artery, half-way down the thigh, care being taken to compress the vessel towards the centre of the limb against the bone; or it may be applied on the popliteal artery, the screw of the tourniquet being fixed over the patella. In either case, about an inch in thickness of the coil of a roller, softened by a few blows of the heel on the ground, or a roll of lint, should be interposed between the pad of the instrument and the skin over the vessel. Supposing the circumference of the limb to be twelve inches, the first incision through the integuments should be reflected back to the extent of about two inches and a half, and rather higher over the projecting bone than over the retracting muscles behind it. The operator, standing on the right side of the limb, now endeavours to divide all the projecting muscles by the circular sweep of the knife. But in this act some tact is requisite, lest the loose gastrocnemeus muscle, being unconnected with the bone, be pushed before the knife, and divided obliquely. A fine catlin introduced between the bones will complete this division of the muscles. A linen retractor, triple-tongued, should be employed to protect the muscles from the saw, and to expose the bone as high as possible; and the bones should be sawn together, by adapting the edge of the saw to both at the same time. The front edge or spine of the tibia may be afterwards removed to the extent of half an inch. The direction of the cicatrix, whether transverse, vertical, or oblique, may wait on the option of the operator, and be determined by the convenience of dressing, or by the liability of the tibia to exposure by after retraction of the flap.

Reflection of integuments.

Avoid oblique division.

*Double Flap Amputation at the Calf.*—The operator stands on the right side. A small anterior flap of integument only is made in front of the tibia, extending outwards as far as the fibula, and should be reflected. A long, pointed, narrow knife, double edged at the point, is then introduced along the posterior surfaces of the two bones, and brought out on the opposite side of the limb. This posterior flap is then cut downwards from the bones to a sufficient extent to cover the end of the stump. But as the mass is thick, and will require a good deal of integument to cover it, this flap is usually made very long. I have seen it often of six inches in length. The division of the soft parts is completed by the catlin. These edges are then adapted. This is a very objectionable operation, obeying none of the requirements, which are imperative in flap operations elsewhere. The bone lies at the side and not in the centre, the anterior flap is

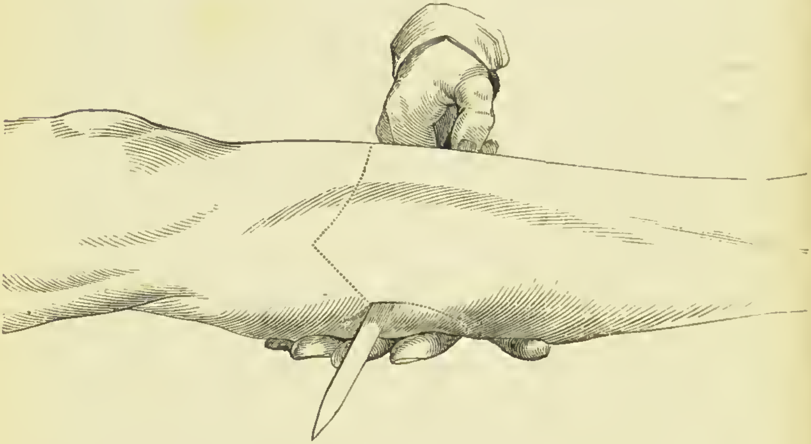
Mass of muscle excessive.

Disproportion of parts.

exceedingly thin, the posterior flap exceedingly thick and disproportionate in size, and this fleshy mass is brought entirely over the ends of the bones, and there is no correspondence between the flaps when attempted to be brought into apposition. The thickness of the calf renders it unwieldy and inflexible; and projecting at the angles in an unsightly manner, it has all the appearance of a displacement of the calf. The objection to this operation lies in the mass of substance carried forwards, and this may be avoided by a better operation, which I have for many years adopted, and which appears to me an improvement on the former.

Improved operation.

*Amputation at the Calf by transfixion of the Calf in part only.*—The operator stands on the right side of the patient. The leg being raised, the calf is supported on the open palm of the left hand of the operator, by which it is flattened out considerably in breadth. The knife is then introduced through the skin at a depth of not more than half or three-quarters of an inch above the palm of the hand, and passed straight across to the opposite side, and the posterior flap, which in addition to the integuments will thus include a small thin portion of the gastrocnemeus, is formed of sufficient length to pass forwards around the end of the tibia. The anterior flap is now cut, but of small dimensions. A circular sweep of the knife around the limb is then made, which divides the rest of the calf, and the catlin is introduced through the



deep muscles and interosseous membrane. By this means a posterior flap is formed, which being thin corresponds with that in front, in size and substance, and leaves little or no muscle for after-absorption. When the entire calf is brought round the bone, I have known upwards of three months required for the healing process, and in such operations, when the calf is large, the aspect of the stump is almost ridiculous.

Avoid division of ligamentum patellæ.

In amputating the leg immediately below the knee, it is very desirable to avoid the division of the ligamentum patellæ, if possible; not with the idea that the muscles inserted into the patella will thereby lose their function as agents of extension of the leg, but because the action of one of them, viz. the rectus, will be compromised as an agent of flexion of the thigh; and, certainly, if the tibia be divided as high as the tuberosity, too small a portion of the bone will be left for convenience in kneeling on the cushion of the artificial support.

These operations are performed on the same principle as that last described, taking a small thickness only of the gastrocnemeus, in addition to the skin, to form the posterior flap, supposing the flap operation to be selected; but the circular operation is not unsuitable to this region, because the muscles behind are thinner, and the bone projects more considerably towards the back part of the limb.

Head of fibula.

There can be no necessity to remove the head of the fibula, nor any advantage from this unnecessary addition to the operation, but not on account of the reasons usually assigned by authors, viz., that the articulating surface communicates with the sinovial membrane of the knee-joint, which it assuredly does not do, except in very rare examples of structure; of the flexors of the leg, the semi-membranosus alone will escape division in amputation as high as the tuberosity of the tibia.

*Amputation of the Leg between one and four inches above the Ancle-joint.*—This operation is necessary when the bones and entire structures of the tarsus are so far injured or diseased, as to render the removal of the whole foot compulsory. The advantage obtained from selecting this situation is that of its convenience for the application of an artificial foot, or some permanent support, as a substitute for the foot. It is therefore, for the most part, unsuitable to the necessities of hospital patients. Ten muscles will require division, the larger number of which are reduced to tendon; the stump will necessarily, therefore, be integumental.

Double flap unsuitable.

The tourniquet may be applied in the ham, with the addition of a compress of linen placed underneath the pad of the instrument. The double flap operation by transfixion is unsuitable to the structures to be divided. The division of the tendons can never be cleanly and well effected by the flap operation. They require a transverse section while supported behind. The best operation is that of the double flap of the integuments. These should be made in front and behind, and ample, though not excessive in length. Supposing the leg to be nine inches in circumference, each flap will be required of the length of about two inches, allowing for the retraction of the integuments. The flaps should not be too much arched, but so made as to meet along a nearly straight line. The centre of each lateral aspect of the leg may form the extremities of each arch. The muscles and tendons being divided, the catlin should be used with some care, and the incision effected by it be smooth and not jagged. A triple-tongued linen retractor should be employed, and the bones sawn together. The three arteries of the leg may require ligatures.

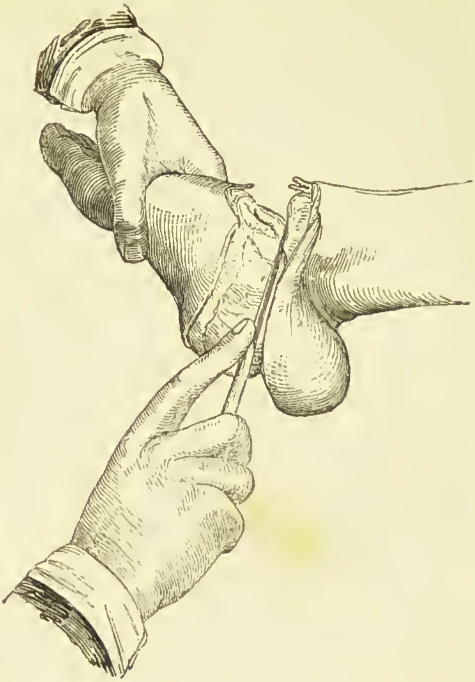
Flaps not too arched.

## AMPUTATION OF THE FOOT AT THE ANCLE-JOINT.

Syme's operation.

The great importance of retaining as much of the lower extremity as possible, has led to a good operation, which was first adopted by Mr. Syme, of Edinburgh, viz., amputation at the ancle-joint, for the removal of the foot. The tourniquet may be applied in the ham. This operation is thus performed.

An imaginary line is drawn round the sole of the foot from each ancle, inclining a little backwards, and this constitutes the line of the first incision, which is to be carried down to the bone, throughout its entire length. The foot is now raised, and held firmly by one, or even two assistants, or supported off the level of the table or bed by a firm pillow, placed at a little distance above the ancle-joint. The operator then proceeds to reflect the integuments with the subjacent fat from off the os calcis, until it is completely separated from the bone, and pushed loosely backwards, exposing about an inch of the tendo Achillis, which tendon may be at once divided. The upper angles of the first incision are then connected by a nearly transverse line across the front of the joint, which should penetrate the cavity. The lateral ligaments may then be divided, the foot dislocated from its socket in the tibia, and 'the remaining tendons divided. The foot being thus separated, the flap is then drawn forwards over the ends of the tibia and fibula, and united by suture and plaster. The stump will require the pressure of cotton wool, in consequence of the solidity of the flap adapting itself somewhat imperfectly to the cavity, in the end of the tibia.



Retain the bones.

*Amputations between the Bones of the Tarsus.*—It is the duty of the surgeon to retain as much of the foot as possible, in all diseases involving only a part of its structure. As these are among the most difficult of the amputations, it is very necessary that the bony structure of the foot be carefully studied before proceeding to amputate, and the best evidence be obtained in determining the extent of the disease or injury it may have sustained. As a rule, no artificial support can compensate for the loss of the natural structures.

Pirogoff's operation.

It was, doubtless, such considerations as these which suggested to Pirogoff a modification of Syme's operation. In Syme's operation, as we have seen, the *whole* of the tarsus is removed; in Pirogoff's operation, more or less of the posterior portion of the os calcis, with the tendo Achillis attached, is retained. This operation, up to a certain point, is performed in the same way as the former; but instead of dividing the tendo Achillis and dissecting the os calcis out from the heel, the bone is sawn through, and the cut surface is subsequently brought up in apposition with the sawn end of the tibia. Mr. Busk, whose experience of this operation is probably larger than that of any other English surgeon, has recommended that the section of the os calcis be made obliquely, downwards and forwards. The advantages of this are, that a larger surface is thus brought up to the tibia; that the tendo Achillis is not so much stretched; and, lastly, that the patient subsequently walks on that part of the bone which is naturally adapted for the purpose. Pirogoff's modification no more detracts from the original merit of Syme's operation than does the improvement of Mr. Busk from that of Pirogoff.

## AMPUTATION ACROSS THE MIDDLE OF THE TARSUS, OR CHOPART'S OPERATION.

By this operation, the astragalus and os calcis of the tarsal bones are alone retained. The articulation between these bones and the navicular and cuboid is opened nearly directly across the foot. But this portion of the foot gives a firm support to the body in progression, and is greatly preferable to any artificial agent, although forming little more than a mere pillar; for, though the movements of the ancle-joint remain unimpaired, yet the actions of all the muscles of the foot are destroyed. Indeed, those of the calf of the leg are the sole remaining agents which retain their insertion; yet their function is destroyed by the removal of the foot, their office being that of raising the weight of the body upon the distal extremity of the metatarsal bones; but as these bones are removed, the function of the muscles is lost, and the muscles of the calf must always be absorbed in cases in which the above amputation has been practised.

When required.

Chopart's operation on the foot is required in disease or injury of the metatarsus, probably involving the five smaller tarsal bones. In examining the articulated foot, it is apparent that these bones, viz., the navicular and cuboid, are connected to the astragalus and os calcis along a nearly straight line. This line may be determined with some precision by the following rule. About half-way along the outer edge of the foot, the fifth metatarsal bone will be distinctly felt to project. In a line backwards from the proximal surface of this rounded projection, measure three-quarters of an inch, and mark the point. This distance of three-quarters of an inch corresponds with the outer edge of the cuboid bone; and from this point draw a line inwards of one inch in length across the foot. This line will correspond with that of the articulation between the os calcis and cuboid bone. To discover the articulation of the navicular bone with the astragalus, pass the thumb with some force of pressure over the inner side of the foot, an inch and a half in front and below the internal malleolus. The projecting bone then felt is the naviculare. This process gives insertion, below it, to the tibialis posticus, but its articulating surface, with the astragalus, is half an inch posterior. One inch, therefore, obliquely downwards, from the anterior surface of the malleolus towards this projecting process of the navicular bone, will correspond with the joint. This point should be marked, and from it a gently curved line should be drawn, arched forwards, to the outer side of the foot. This line will mark that of the articulation

between the astragalus and navicular bones. A small flap is made from above; the larger one from below. From the upper surface, the flap is formed by cutting about half an inch longitudinally, quite on the inner side of the foot, and then carrying the incision nearly transversely across the dorsum, but slightly arched. This incision should pass down to the bones, and the flap be reflected. In making the lower or plantar flap, it should be kept in mind that the foot is considerably thicker on the inner than on the outer side, and consequently that this flap must be formed obliquely. The necessary apposition of the surfaces renders the formation of this flap by cutting from within outwards, after opening the joint, exceedingly difficult, the flap thus made being mis-shaped and unnecessarily thick. It is, therefore, advisable to make it below, commencing from the end of the first longitudinal incision (suppose on the outer side), and carrying it across in an oblique direction, forming a flap of nearly two inches in depth, until it reaches the articulation of the metatarsal bone of the great toe. It should then be carried backwards in a continued curve to meet the other extremity of the first flap. It is not desirable, in this lower flap, to dissect back the entire substance of the sole; but, as in the case of amputation of the calf of the leg and elsewhere, to take a part of the thickness only, and especially at the beginning of the flap, increasing its thickness as it is reflected. The joint should then be opened above, employing some force of depression of the foot with the left hand; *but not using force of pressure with the knife;* for the joint, which is close at hand, should be opened by tact, and not by force; and if the knife be applied to the right surface, it will pass without effort into the articulation; if in the wrong direction, no force will effect it. By such attempts to bring the operation to a close, it is generally prolonged considerably. The remaining soft parts being divided, the flaps are brought over the bones. Two or more arteries may each require a ligature.

Lower flap from the skin inwards.

Tact, not force, required.

## AMPUTATION AT THE TARSO-METATARSAL ARTICULATION —HEY'S OPERATION.

This operation was first practised by Mr. Hey, and subsequently recommended and adopted by Lisfranc. It consists in the removal of the five metatarsal bones from the tarsus. This line should be thoroughly studied by the operator on the articulated foot, before proceeding to operate. Its general direction may be ascertained with sufficient accuracy in the following manner. The projection of the fifth metatarsal bone is always distinct. At its connection with the cuboid, this line commences on the outside, suppose of the right foot. On the inner side, the projection of the navicular bone is almost equally distinct on pressure. Press the last joint of the thumb vertically on this process, and the breadth of the thumb will correspond with that of the bone; measure one inch exactly in an ordinary sized foot lower down, and we have the line of articulation between the first metatarsal and the internal cuneiform bone. Unite these points by an arched line passing across the dorsum, corresponding with the natural arch of the foot, thus, making the centre of the arch correspond with the second, and not the middle, metacarpal bone. This imperfectly formed arch would be complete but for the second metatarsal bone, which projects backwards beyond the line of the rest, to the extent of a third of an inch, interrupting the continuity of the line across the foot, and articulating not only with its own cuneiform, but with the external and internal cuneiform and third metatarsal bones.

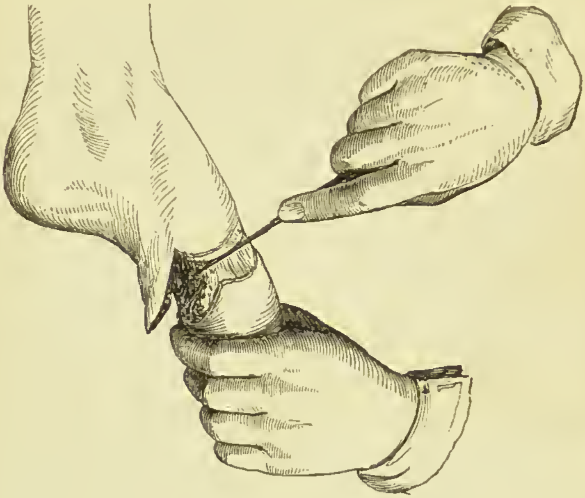
**Line of articulation.**

**Second metatarsal bone.**

An incision should be commenced on the outside of the foot on the fifth metatarsal bone, carried a little way down longitudinally, and then across the foot; half an inch below the line of the articulation, the distance increasing a little towards the great toe, and terminating well on the inner side of the foot. This slightly convex flap being reflected, the under, or plantar flap should be made by an oblique incision, extending two-thirds along the metatarsal bones, and then carried back obliquely across that of the great toe, to join the inner extremity of the first flap. Part of the muscular substance of the

**Plantar flap.**

sole only should be reflected towards the margin of the flap, but more towards the base. The joint being opened above, we come to the obstruction of the second metatarsal bone, which should be divided by a pair of bone forceps, and not attempted to be disarticulated. Except in very experienced hands this is a very tedious undertaking. One or two ligatures may be required, and the flaps united by suture and plaster.



Equal thickness of flaps.

In the two last examples, the double flap operation recommended is, I think, preferable to the single flap. The line of junction may be made across the middle of the stump, or, as above given, somewhat higher; but pains ought to be taken to ensure some correspondence in the thickness as well as in the form of each flap.

If the material of either flap be imperfect, consequent on disease or injury involving the skin, sufficient integument may be obtained for a single flap either above or below. In reflecting the flap from above, I see no advantage in including the extensor tendons or the extensor brevis muscle.

The following plates represent the incisions and the disarticulations in the three operations just described.

Fig. 1.

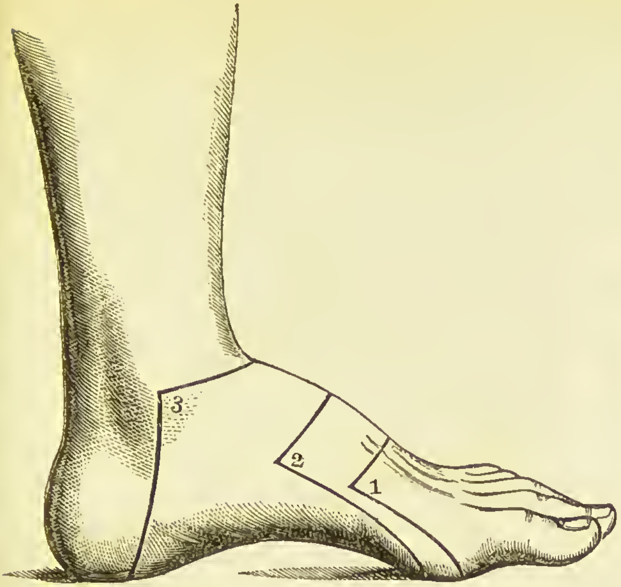
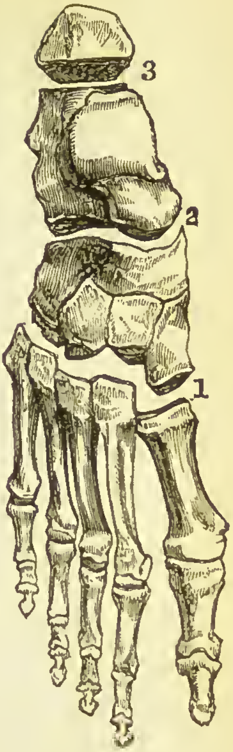


Fig. 2.



## AMPUTATION OF THE GREAT TOE, WITH ITS METATARSAL BONE, AT ITS TARSAL ARTICULATION.

This ought to be an operation rarely performed, for the value of the proximal extremity of this bone is valuable, as forming the insertion of the peroneus longus muscle. As a general rule, therefore, it is very preferable to divide the metatarsal bone by the saw or by bone forceps, instead of disarticulating it. The line of the articulation may be ascertained by the rule given in the last operation. The vertical measurement, or the thickness, of the tarsal end of the metatarsal bone, in a foot of ordinary dimensions, is one inch and an eighth, and the surface of the cuneiform bone requires, therefore, a flap of ample size. When required to be removed at the articulation, make the measurement, and mark the line of division by means of a loop of cord or string. This loop should be formed of seven inches in length of cord, and passed over the great toe, the end of the cord being

Articulation to be covered, large.

Loop of cord.

drawn tight along the inner side of the foot, just below the inner ancle. Mark well this line, and commence by placing the foot firmly on the heel, and inclined forwards in extension. With a strong but narrow scalpel, and at the same time holding the toe firmly, and drawing it from the rest of the foot, cut down along the dorsal line, over the metatarsal bone, to its inner side, continuing the incision for nearly an inch beyond the articulation about to be opened. Make a similiar incision below, in both cases cutting cleanly upon the bone. Reflect the flaps backwards, open the articulation, and remove the remaining soft parts. The two opposite edges of the flaps will perfectly correspond.

If having exposed the metatarsal bone, it be not found indispensable to disarticulate it, the application of bone forceps, or chain, or metatarsal saw, half an inch only lower down the bone, will save the peroneus longus.

## FOR THE REMOVAL OF THE LITTLE TOE, WITH ITS METATARSAL BONE.

A loop of similar dimensions will be required, but the loop should be drawn backwards, quite along the outer side of the foot. The operation is performed by the same method as that adopted in the last case.

## AMPUTATION OF THE GREAT TOE.

Sesamoid bones.

The articulation of the great toe with its metatarsal bone, forms also a very large joint. The size is rather due to the metatarsal and sesamoid bones than to the phalanx, and the consequence is, that sufficient integument is not invariably left to cover it, when the operation is performed without rule or without sufficient consideration. If four inches and a half of string be formed into a loop, and drawn over the great toe, it will form a very obtuse oval, approaching to a circle around the toe. But this line of incision is necessary to insure the retention of sufficient integument to invest the distal end of the large metatarsal bone it has to cover, the size of which is yet increased by the presence of the sesamoid bones, which, supposing ample integument to be left, need not

Loop of cord.

be disturbed from their position. This nearly circular incision should be made firmly, that the tendons may be at once divided. It is of no importance in what aspect it is commenced. The bone being cleared all around of its soft parts, the joint is opened, and the phalanges removed.

**Double flap.**

A second mode of effecting this operation of the great toe is by a double flap. Bend the toe downwards, and make a dorsal flap, which is carried round across the middle of the phalanx, from the integumental fold, between that and the second toe, to the side of the ball of the first toe, and reflect it. A similar line below, uniting the ends of the first flap by a circular sweep of the knife, forms the lower flap. The bone is then disarticulated, and the lower flap completed by cutting out. A third mode of performing this amputation, which insures sufficient integument, consists in making a straight longitudinal incision along the inner side of the toe, commencing about half an inch behind the articulation, and carrying it onwards to the middle of the first phalanx. At this end of the line make a circular incision around the toe down to the bone, reflect back the integuments and soft parts from it, and open the joint from above. These operations on the toe often require a ligature, or even two.

**Circular flap.**

## AMPUTATION OF THE PENIS.

In this amputation, we endeavour to avoid excess of integument, by drawing it downwards at the moment of division. The organ is to be elongated by the left hand of the operator, and cut through by one sweep of the knife passing obliquely from behind forwards, for the purpose of leaving the urethra and spongy body somewhat longer than the rest of the organ. This is done with a view to keep the orifice of the urethra clear of the cicatrix. Two ligatures may be required.

# CHAPTER XIII.

## EXCISIONS OR RESECTIONS.

APPLICATION OF THE TERM—A SUBSTITUTE FOR AMPUTATION—OVERLAPPING OF BONE IN FRACTURE—UNUNITED FRACTURE—UNSUCCESSFUL—LESS APPLICABLE TO THE LOWER THAN THE UPPER EXTREMITIES—SPECIAL EXCISIONS—LOWER AND UPPER JAW—EXCISION OR RESECTION OF VARIOUS JOINTS.

The last quarter of a century has been a fruitful period in the performance of these operations, and the records of surgery in Britain and elsewhere teem with abundant evidence of the practicability of this valuable step in the onward march of judicious operative surgery. By this operation we remove by excision any portion of dead or diseased bone, whether composing a part of a joint, or of the shaft. It is often practised for the removal of a joint of which the bony structure is the seat of disease. Thus it becomes a grand substitute for amputation in diseases of joints, and as such may be often classed among the most efficient operations in surgery, for the destruction of the joint, whether shoulder, or elbow, or wrist, such is the conservative power of nature, is yet compatible with a good deal of useful movement of the limb. But the success that has attended it, and that has interposed itself between the disease and the amputating knife, presents no small temptation to its performance in cases in which the resources of curative surgery are yet unexhausted; and I therefore recur to a remark I have previously made in reference to the subject of amputations in general, that diseases that are curable, and are cured in one hospital, are removed in another; and consequently we are not justified in resorting even to the lesser expedient of the excision of a joint, or a part of it, until every remedial agent of cure has been tried without success. The knowledge both of these agents and of the order and degree of their influence, constitutes

Application of the term.

The last resource when all remedies are exhausted.

a distinct branch of surgery from that which forms the subject of this volume. A surgeon who has exhibited the highest competency to the performance of difficult and rare operations, may be less competent than another to wield the curative agents referred to; and looking to the aggregate of medical men, it will be readily allowed that pre-eminent merit in both departments of surgical practice, is, on the whole, more exceptional than common. Although the excision of a joint may redeem a limb from amputation, it does not sanction the resort to the knife, by the smallest relaxation of the imperative rules that can alone justify the resort to the larger operation. The same incurability of a joint, and all the same conditions that justify amputation, must be thrown into the scale, to warrant the lesser operation of excision. If the disease be incurable one of two operations must be resorted to, and of these, excision presents less of objection than amputation, and therefore we have recourse to it.

**Resection, or amputation.**

So far as the important end is achieved of the removal of disease, and the re-establishment of health, it is undeniable that much benefit may accrue to the subjects of the operation; but I think we should be careful how we hold out promises of recovery, or pledge ourselves to regenerate locomotive power, in the cases of operations for excision of the joints, especially of the lower extremity. The functions of the upper and lower extremity are so widely different, that an operation which may afford considerable benefit in the one case may terminate most unsatisfactorily in the other.

The operation, to which the somewhat inapposite title of "resection" is commonly applied, is not confined, however, to the excision of joints, but applies on a minor scale to many occasions, such as the removal by the saw or forceps of the overlapping ends of bones, in recent or in old fractures, in cases, also, of ununited fracture, or to the removal of either maxillary bone.

**When applicable.**

When in cases of fracture of the long bones, the attempt at reduction by elongating the limb fails to restore the bone to its natural relations, when the overlapping is considerable, and the projecting end of the bone great, promising positive abridgment of the length of the limb, if the bone protrude against the skin, by which it is chiefly covered, as on the inner side of the tibia, for example, or the fibula; if the movements of the fore-arm be impaired by fracture of either bone, on the same conditions, it may be desirable to cut down on the projecting bone and remove it. For this purpose an incision, sufficiently short in length, should be made upon the bone, which is further freed by the knife in dissecting around it; the limb is then bent at the fracture, so far as to protrude the bone through the wound. The soft parts being well protected by a thin plate of any metal at hand, by a copper spatula, or the blade of an amputating knife, the protruding bone is removed by the saw, or by the bone forceps, and the parts restored, the outer wound being carefully brought into exact apposition. It is hardly necessary to say that it is undesirable to cut deeply into the muscular structure of the limb.

**Ununited fracture.**

A similar operation may be required for the purpose of removing the ends of the bone in ununited fracture. It occasionally happens, after fracture, that the usual period expires without the least union of the broken bone; and weeks or months may elapse, often under the best management, without any attempt at reparation being made by the bone. But this result may originate in two causes, essentially distinct in their nature from each other. The one is dependent on local, the other on constitutional causes. In the one case, the difficulty has arisen, either in part or entirely, from the want of careful apposition of the broken ends, or from the want of perfect rest; in the other, from deficiency of ossific action. In the first example, the shaft of the bone retains its natural thickness up to the broken extremity, where more or less callus is deposited; whereas, in the case of deficiency of ossific power, the bone is attenuated up to the broken part, and there is a total want of callus deposit, provisional or permanent. This distinction can generally be ascertained before operating, by the pressure of the fingers on the fractured part. Many means have been resorted to by surgeons to regenerate this want of action, by cutting down to the fracture and filing the ends of the bone, or sawing them off; or without the employment of the knife, to rub them with force against each other, or to pass a seton thread across the interval of the ununited bone.

**Dependent either on local or constitutional causes.**

**Surface**

Whatever operation be resorted to, it is desirable to selected for operation.

select that aspect of the bone that is most accessible, and will less injuriously involve parts beneath, that are essential to the structure of the limb. The humerus should be exposed on the outer edge of the triceps muscle; the radius or ulna on their posterior and lateral surface; the femur on the outer side of the thigh, by cutting through the vastus externus anterior to its origin from the linea aspera; the tibia on its inner side.

An incision of sufficient length being made down to the bone, each extremity of the fractured bone is alternately brought to the outer wound, and a chain or fine saw applied; removing from a quarter to half an inch, or even more, where it is evident that absorption of the bone has taken place. Great care must be taken to avoid the presence of any bone dust in the wound. The ends of the bone being replaced, and the wound carefully united by plaster, the fracture is to be put up, care being taken that the ends are brought into perfect contact, and retained there. The success attendant on this operation is unfortunately not very general. The want of power being rather the result of constitutional infirmity.

## EXCISION OF THE LOWER JAW.

Necrosis.

The lower jaw is occasionally the seat of disease involving its texture, whether originating from the periosteum or from the internal structure of the bone. It is also liable, in common with other bones, to necrosis. Well authenticated cases are on record, in which the entire of the lower jaw has separated, in a state of necrosis, and partial separations are by no means uncommon. Of the former, the museum of St. Bartholomew's contains a fine specimen, and a second occurred in the wards of the hospital, under the care of my colleague, Mr. Stanley. Diseases arising from the periosteum are generally more or less hard and fibrous in their texture, and of slow growth. These diseases, whether osteo-sarcoma, fibrous tumours, or exostoses, require the removal of the part of the bone from which they arise. When taken early, a section of the bone only, may be involved; but if far advanced, the excision of the entire bone may become necessary. But the necessity for this operation is a very uncommon one, the disease rarely extending beyond the angle of the bone. It will be recollected that the ramus of the lower jaw, beyond the angle, is flat and thin, and receives the insertions of the masseter and internal pterygoid muscles. This portion of the bone is less liable to disease than other parts, whether benign or malignant.

Cancer.

Cancerous affections generally originate in the cancelli around the alveoli, and involve the body of the bone, from the angle to the symphisis. Under the various titles of cancerous, fungoid, or medullary tumours, this disease extends, pushing outwards the lower part of the cheek into a rounded form. In fibrous or osseous tumours of slow growth, the removal of the lower jaw, or a part, is an operation called for by judicious surgery; and may be undertaken with a good prospect of a favourable result, but in cancerous, medullary, or fungoid disease of this bone, its excision is rarely, if ever, successful in eradicating the disease from the system.

Fibrous tumours.

Case.

I removed a portion of the lower jaw from a lady, who had fungous, thread-like processes shooting out from several of the alveoli of the lower jaw, on the right side. The teeth had been drawn in consequence of the disease, when incipient. The case was seen by two or three surgeons of competent judgment, and all of whom concurred with me in recommending the operation as the only treatment likely to prove permanently successful. I divided the jaw at the symphisis and at the angle, nearly an inch beyond the part apparently affected, as proved by subsequent examination, and detached the insulated portion. The disease returned within twelve months, reached a frightful magnitude, and destroyed her. In this case we had every warrant for the operation, and abundant promise of success. The disease was comparatively recent, the growth small, the surrounding parts not involved. The division of the bone exceeded the dimensions of the disease, by half an inch in front, and by full an inch behind, and yet it returned with all its violence, involved all the surrounding structures, raised a mass of enormous magnitude, encroached on both trachea and œsophagus, till she was worn out and died.

In malignant dis-

Excision of either the upper or lower jaw was an operation much in favour with hospital surgeons up to the last ten or fifteen years. Comparatively speaking, it is now rarely performed, and for this reason, that it does not afford the remedy promised; and it behoves all surgeons to pause before having recourse to it, and to ascertain the general, if not the precise nature of the disease for which it is applied: in fibrous tumours of bone, the prospect is a favourable one; in malignant disease, most unpromising.

ease, rarely successful.

Line of incision.

The patient should be placed in a high-backed chair, with the head well supported by an assistant. Supposing it intended to remove the body of the bone to the angle, a firm incision should be made along the line of its basis to the above extent. This incision will necessarily divide the facial artery, which will bleed freely, and should be immediately tied. The knife should then be passed upwards into the mouth, separating the cheek along the same line from the gum, the point being guided within, by the fingers of the left hand. When the outer surface of the bone is clear, the knife should be again introduced near the symphysis, *inside* the bone, aided by the fingers employed in depressing the tongue and sublingual gland, to protect them from the knife, and should divide the muscles attached to its inner surface, but chiefly the mylo-hyoid. The attachment of the genioid muscles to the symphisis may render their division unnecessary. The division of the bone at or near the symphisis will require the application of the saw, and may be completed by the forceps. The masseter muscle is to be raised from its insertion into the angle, and the bone cut asunder as before. The operation is a simple one, may be performed in a short space of time, and leaves little deformity, or other evidence of its extent.

Extension of disease to the ramus.

The necessity of removing the ramus also, in addition to the body of the lower jaw, may be either determined previously, or its decision may await the completion of that stage already described. If we have proceeded to the exposure and denudation of the body of the bone, and it is then obvious that the disease extends up the ramus, there is no alternative but its removal. But as every quarter of an inch increases the difficulty of the undertaking, so it may be advisable, in cases of fibrous disease especially, and not of the malignant kind, to divide the ramus, leaving the condyle and coronoid processes untouched. The operator proceeds by a vertical incision through the soft parts, along the ramus, at about a quarter of an inch from its posterior margin, made down upon the bone. This incision will divide the transversalis faciei artery, the parotid duct, and the portio dura nerve. The masseter muscle is dissected rapidly from the bone. The ramus may then be sawn across, or the condyle exposed and disarticulated, and the insertion of the temporal muscle to the coronoid process divided.

In removing these two processes, the edge of the knife should be kept pretty close to the surface of the bone, in order to avoid the temporal artery, and also to the inner surface of the ramus, while detaching it from the internal pterygoid muscle; by which means the trunk of the internal maxillary artery will also escape division by the knife; but that of its primary branches, the dental and muscular, is inevitable. The flap should be brought into exact apposition, and supported with moderate pressure through the medium of cotton wool, or some soft material.

## EXCISION OF THE UPPER JAW.

Relations of bone should be studied.

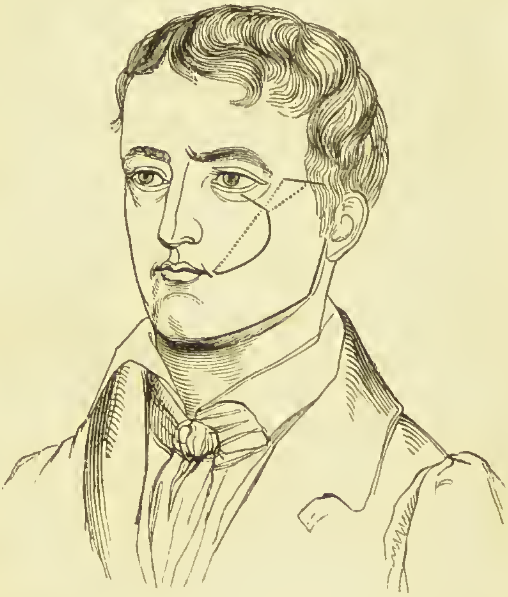
Before proceeding to this large operation, the relations of the bones should be sufficiently studied on the skull. It will be observed that the superior maxillary bone enters into the formation of the nose, forms the greater part of the floor of the orbit, on which the apparatus of vision rests, is connected largely to the malar bone, and forms also the greater part of the floor of the nostril and roof of the mouth. Its relation to the palate bone along the roof should be noticed especially, because this latter bone holds important relations to the velum palati, and should be retained, if possible; and the more so, because it is rarely involved in the disease.

Malar bone involved.

The patient should be seated in a chair, with the head supported, as in the former case. If placed horizontally, the blood will flow back into the fauces, to the great annoyance both of the operator and the patient. The middle incisor tooth of the affected side should be previously drawn. The extent to which the malar bone is involved may be a matter of uncertainty. If involved, its removal will form no considerable addition to the extent of the operation. The nature and extent of the external incisions must be in some degree determined by the form and extent of the tumour. The soft textures of the face, composed of skin, muscles, and fat, must be raised from off the maxillary bone; and there are no vessels of sufficient magnitude, to qualify the incisions to be made, which are regulated partly by the convenient exposure of the bone, and partly by the necessary restoration of these structures to their former relations. The lines of incision should be carefully noted.

**Lines of incision.**

The first incision, as recommended by Mr. Liston, is made from the external angular process of the frontal bone to the angle of the mouth, dividing all the soft parts down to the bone; a second incision, commencing on the nasal process of the maxillary bone, is carried vertically downwards, through the upper lip, separating the side of the nose, by detaching the nasal cartilage from the maxillary bone. Thus a vertical flap is made, hanging from above. This flap is to be raised, and dissected off the maxillary and malar bones, to the infra-orbitary ridge, dividing the elevator muscles of the upper lip, and infra-orbitary artery and nerve. The dissection is then carried into the floor of the orbit, and the knife employed in separating the inferior oblique muscle, and other soft parts connected with the eye, from the orbitar plate. If it be then found necessary to remove the malar bone, an incision should pass backwards along the line of the zygoma, and reflected from the bone.



Removal of malar bone.

The entire of the front surface of the maxillary bone being now cleared, cutting bone forceps, of large size, should be used to divide the malar at its connection with the maxillary bone, or to divide the malar through the zygoma. The next division by the same instrument is made at the external angular process of the frontal bone; and by employing the instrument as a lever, the orbitar plates of the maxillary and sphenoid will be separated into the spheno maxillary fissure, or the same fissure will be opened by the first application of the forceps between the malar and maxillary bones. The forceps are again applied to the line of junction of the two maxillary bones, the upper blade being introduced into the floor of the nostril, and again obliquely across the nasal process, towards the nasal canal. The bone, with the diseased mass, is then insulated on its sides, and if forced downwards it will be detached from the æthmoid bone; and, if possible, should be separated from its attachment to the palatine process of the palate bone, which may be effected by a transverse division made along the line of their junction with a strong knife, and the mass removed. The cavity should be filled with lint, and the facial incisions carefully brought into contact, and united by five sutures when all bleeding has ceased.

The minor operation.

When the disease in the antrum is limited, and it is obvious that neither the malar bone nor the nasal cavity is affected, the superior maxillary bone may be removed by a simpler proceeding, so far as relates to the external incision, and it is always desirable to incise the face as little as possible. An external incision, commenced below the middle of the orbit, is carried outwards, and running a little beyond the articulation of the maxillary and malar bones, is then curved inwards in a semicircular direction to the angle of the mouth. This flap, which is dissected off the bone and drawn towards the mesial line over the nose, permits the entire excision of the antrum, but leaves behind, undetached, the nasal process of the maxillary bone, and the malar bone; while it permits the division of the maxillary bone from its fellow, or what may be equally desirable, the cutting through the bone itself a little on the diseased side of the mesial line. But when the diseased growth is of uncertain extent, the larger exposure of surface is preferable, and even necessary.

## EXCISION OF THE SCAPULA.

Indications.

This bone may require either partial or entire removal, in consequence of disease involving its texture of an incurable nature. But it is not the presence of every form of incurable disease that will justify the resort to a proceeding so large and so critical as the removal of the scapula, and we are justly restricted in our appeal to the knife to the presence of such disease as presents a reasonable prospect of final recovery. On this principle we exclude every active form of cancer. We do not undertake a large operation with a view to extend the term of life by the addition of weeks or even of months, but in the expectation of prolonging life by a term of years, or of permanently eradicating the disease for the removal of which the operation is undertaken. Excision of the scapula, whether in part or in its entirety, is justified by the presence of tumours not malignant, or any form of growth chronic in its nature, of slow progress, and in which the constitution of the possessor is only involved by the mechanical evil resulting from its magnitude, whether present or prospective.

Excision, whether partial or entire.

The necessity of its removal being determined, the next subject for the decision of the operator is that of the partial or the entire excision of the bone—in other words, is it, or is it not possible to retain that part of the bone which enters into the structure of the shoulder-joint. As a general rule, it is not only possible, but on every account it is desirable to retain it for the future movements of the arm, which, though limited, will be most useful, and we also avoid the great evil of opening the shoulder-joint. If the movements of the head of the humerus in the glenoid cavity are free, and unless the diseased growth encroaches largely on the neck of the scapula, the bone may be divided close to the glenoid cavity and the joint preserved. If the movements of the articulation are impaired by the presence of disease encroaching upon or within it, the entire bone should be taken away. When the tumour is large, it is a formidable operation, as I can myself testify; the exposure of surface is immense, and the hæmorrhage, supposing the operator unprovided with the best means of commanding it, somewhat frightful. I removed this bone in the case of a man brought into St. Bartholomew's Hospital with a very large firm tumour growing from the scapula, from which a lesser growth had been previously removed by my late friend Mr. Earle. The diseased growth equalled the size of the head of a child at birth, but involving the entire of the bone to within two inches of the acromion process. I removed it in the operating theatre with the concurrence of my colleagues, and not without the co-operation of several of them. Had I undertaken the operation without ample assistance, I have no doubt the man would have died on the table, so large was the bleeding from the vessels on each aspect of the bone.

Operation. The operation is performed as follows. A vertical incision is made of about three inches in length across the spine of the bone, and about an inch or more, if justified by the less extent of the growth, behind the glenoid cavity. This incision is carried firmly down to the dorsum and divides the supra spinatus and trapezius above, and the infra spinatus and deltoid below the spine, and the bone itself is cut asunder by the bone forceps, applied first to the spine, and secondly to the inferior costa. The scapula is thus insulated as regards the arm. From the centre of the vertical incision in the skin already made, a second incision is carried inwards along the line of the spine, and at right angles to the former one, the extent of this line being dependant on the magnitude of the diseased growth. If very large, this second incision should curve upward almost immediately towards the mesial line of the neck. The flap thus formed should be reflected upwards, and a third incision, arising from the same point of divergence of the upper line, be carried downwards as low as about the eighth dorsal vertebra, and also reflected. The final division is made by a line drawn downwards, uniting the extremities of the two last incisions, all three of which should be made convex towards the centre of the tumour to be removed. The form and extent of these large flaps should be so calculated as to enable the operator to invest much of the exposed surface on the removal of the diseased growth. The operation now requires merely the entire insulation of the morbid mass, by raising or rather drawing it with some force off the ribs, and detaching all the remaining muscles which connect it to the trunk.

It is an operation which, if previously well studied, requires little more than bold manipulation, and may be completed in three or four minutes. In consequence of the requisite position of the patient, and the consequent difficulty of adapting efficient pressure on the arterial trunk supplying the divided vessels, every precaution should be taken to arrest the bleeding, and to tie them as quickly as possible. The endeavour to compress the subclavian artery on the first rib should moreover be vigorously made.

The flaps of the integument are brought over the wound and united both by suture and by plaster, and the whole surface may be covered with cotton wool and rolled. The arm should be fixed, and retained in its position of absolute rest for two or three weeks after the operation.

## EXCISION OF JOINTS, OR RESECTION.

The operation bearing this title merits the careful study and observation of every operating surgeon.

History.

The principle of excision of the articular extremity of bones, was adopted in the practice of Mr. Filkin, an English surgeon, in the year 1762, and shortly afterwards by Mr. White of Manchester, and other English surgeons. Its application to joints in general was suggested by Mr. Park, and it was adopted on the Continent, both in France and Germany, with increasing success. Sir Philip Crampton excised the knee-joint in two cases, and Mr. Syme the shoulder and elbow joints, about the year 1830. At a later date, and within the last ten years, the operation has acquired a yet greater notoriety, and been marked by increasing success under the hands of Mr. Syme, Mr. Fergusson, Mr. Jones, of Jersey, Mr. Butcher, and many others. To these gentlemen the operation of excision of diseased joints owes much of the favour bestowed on it by its advocates in England; to Mr. Syme in Scotland, to whom the merit of reviving the operation of excision of the elbow joint more particularly belongs; to Langenbach, Stromeyer, Heyfelder, Esmarch, in Germany and Denmark; to Moreau and Larrey, in

France. In our own country, in which the operation of excision of joints owes, we have reason to believe, the first conception, and perhaps the most frequent execution, its adoption is no longer confined to the practice of a few, but is recognised by many surgeons of eminence as the final crisis of the diseased organisation of almost every important articulation of the extremities. And so long as the rules of curative surgery are strictly observed, and the appeal to excision follows in the track of high-classed curative measures, treatment by excision will ever be deemed a valuable resource. But in order to become valuable, the operation of excision must occupy its true position in the scale of therapeutic power, it must be resorted to, only as the substitute for amputation of a limb. It is applicable only to such joints, the diseased or mutilated condition of which is either incompatible with the recovery of their functions as joints, or in which the movements are so fruitful of pain, as to become a source of evil to the constitution of their possessors.

Principle of excision.

In excision of a joint we propose the attempt to preserve a limb from removal by amputation. We do not excise a joint because it is diseased, but because its condition is so incurably diseased, that it must be separated from the body in order to preserve life. There is no question as to the advantage of the one operation over the other, the difficulty in the diagnosis consists in the decision whether either operation shall be resorted to. The knowledge of diseases of joints is only acquired by years of observation. The surgery of the structure itself is peculiar. It has especial claims on the ingenuity of the surgeon, and on his patient reliance on the resources of Nature.

Two suggestions I will venture to make to the young surgeon, with a view to guard him against an error, I fear not a very infrequent one, in the diagnosis of a diseased joint. The first may recall to his recollection a pathological fact, viz., that the absorption of the entire cartilage of a joint lies in the direct path to natural anchylosis. That there is a *vis medicatrix* presiding over the morbid changes in the organism of a joint, will scarcely admit of doubt in the minds of those who have experience of disease elsewhere, and have watched its progress in other textures of the body. And this tendency surely points to the retention of a limb through the medium of anchylosis, if it be possible. How curiously and how infinite in their variety are the resources of Nature displayed in the attempt to retain or to re-model the material substitute for bone thrown off by disease. How beautiful the display of architectural skill!

I cannot refrain from describing an example of this architectural power that was shown me many years since by a scientific friend, and the relation of which is not without its object. The preparation consisted of a portion of the tusk of a large elephant, the hollow cylinder of which had been transfixed by a musket ball, by which the future utility of the instrument had been compromised. To remedy the evil, Nature had thrown across the tube and along the track of the ball, a firm cylinder of bone, from which two pillars of bone were thrown up to support the outer wall of the broken tusk. With such evidence of design and such power of execution can we hesitate in our conviction, that the first aim of Nature is the restoration, if not of the affected joint, at least of the limb, by the union of the bones by anchylosis. The second suggestion refers to the question of freeing the joint of its locked-up contents by a free incision made into it. How much of local pain, how much of constitutional disease may not be occasionally dependent on the presence of fluid penned up within a joint! By its timely removal I have witnessed again and again the subsidence of local pain, heat, and swelling; I have seen the pulse to fall, appetite return, sleep recovered, and finally health regained, with anchylosis of the hitherto intractable joint; and although I do not assert that laying open a diseased joint will invariably attain this salutary crisis, for I have seen it fail, I maintain that at a small expense it will occasionally succeed in arresting the morbid actions, and in the restoration of such as eventually terminate in health.*

Object of excision.

The operation of excision of a joint contemplates the entire removal of the diseased articulation. It is an operation which, applied to the larger joints, is not attended with less danger to life than the amputation for which it is the substitute. This remark applies especially to excision of the knee-joint, but we are warranted in undertaking the somewhat more dangerous operation with a view to the greater gain. We venture more, that we may retain the limb. Let it not be supposed that the excision of the knee-joint is free from serious danger, and especially when undertaken on account of such injury as arises from a musket-ball or from a violent wrench of the articulation. A recent shock, whether from one or other of these causes, finds the constitution ill-prepared for a large operation; while, on the other hand, a system exhausted by protracted pain and profuse discharge is equally disqualified to sustain the shock. It is highly probable that the constitution is less tolerant of violence done to a sound than to an unhealthy joint; but when we recollect the great amount of local irritation and the continued drain on the circulating system so frequently following the operation of excision of the larger joints, we must be especially careful how we venture on so hazardous a proceeding in persons who manifest signs of the exhausting effect of protracted disease.

---

* With the success attendant on this practice by which so many limbs have been preserved, no surgeon is more honourably associated than Mr. Gay, and I refer the reader with much pleasure to his written testimony on the subject. My colleague, Mr. Lloyd, has also for many years adopted this treatment, and I know that in so doing he has often rescued a limb from amputation.

Excision of a diseased joint proposes the removal of such morbid textures as have become a source of evil to the constitution. All the components of the joint may be involved in the morbid change—sinovial membrane, cartilage, ligament, and bone. It should, however, be remembered that the disease itself is not specific in its nature, and that under most circumstances the new joint is the seat of a large drain of matter, and textures of all kinds undergo important changes by which their natural functions are abrogated. It would be difficult to imagine a portion of sinovial membrane, adherent to the bone after excision and involved in the new actions consequent upon it to retain the power of secreting sinovial fluid, or, indeed, of being provided with blood-vessels competent to secrete any fluid. One form of disease of this important membrane being more obnoxious than others, viz., the "pulpy thickening" of Sir B. Brodie, may render its entire removal a desideratum — but not at a large expense to the bone—for it may be doubted whether a portion of the pulpy membrane retained under the altered condition of the joint would be attended by any serious consequences.

The extent to which cartilage should be removed will greatly depend on the proposed functions of the new joint. If it be proposed that the bones be brought into apposition with a view to anchylosis, it is obvious that all interposing cartilage with its lining investment of sinovial membrane should be removed. But again the question arises as to the necessity of dividing the bone at any considerable distance from its extremity for the mere purpose of getting rid of the entire cartilage, and especially so when we recollect that the sinovial surface of cartilage possesses in all probability the lowest secreting power of the entire membrane. A joint intended for anchylosis demands the close apposition of the opposite bones, the articular ends of which should of course be removed by the saw. The extent of this apposition of the opposing bones is, to say the least, an unsettled question in surgical practice. Some surgeons do not place the bones in *absolute* contact after the operation, a small interval in the case of excision of the bones of the knee-joint being retained throughout the after treatment. By such means, coupled with the most absolute quietude, both of the joint and of the person of the patient, the process of anchylosis is supposed to proceed more favourably towards its completion.

On the other hand, it may be urged that between the two relations of the opposing bones, viz., the existence of an interval between them, and their absolute contact, supposing it effected without injurious pressure, general experience would rather favour the latter mode of treatment. The great after difficulty arises from local disturbance, causing profuse secretion from the joint ; and it is not an unreasonable supposition, that the presence of an interval between the bones must tend to the encouragement of such actions within the joint as, to say the least, protract recovery. Mr. Jones of Jersey, a man of large experience in this branch of surgery, adopts the treatment by absolute contact, and I confess I am inclined in the same direction.

But in cases in which it is proposed to retain some degree of motion, as in excisions of the joints of the upper extremity, the removal of the entire cartilage is not requisite; and it is the practice of many surgeons to saw off the articular end of the humerus in operations on the elbow-joint, for example, but to leave the opposite bones untouched. If, then, no evil arises from the presence of cartilage in the new joint, it affords a strong presumption in favour of a more limited division of the femur in cases of excision of the knee-joints than has been commonly adopted.

With regard to division of the bone in the operation of resection, it is desirable, as a principle, to retain as much as possible, and especially in operations on the lower extremity, not only for the purpose of maintaining equality in the length of the limbs, but of retaining the largest extent of surfaces for future junction. This indication, so palpable in its reasoning, may, however, demand considerable modification under circumstances of powerful muscular contraction, which can only be met by the division of the shaft of the bone at some distance from the joint. The process of anchylosis demands the presence of healthy bone, and as a general rule we find the bone in a condition not unsuited to the process of union. In examples of great softening, such as are incidental to protracted strumous disease in young persons, it may fairly be presumed that anchylosis is impracticable. In such cases the operation of excision of the knee or ancle joints is contra-indicated.

It is obvious, then, that the operation of excision as applicable to the knee contemplates an ultimate issue, essentially distinct from the same operation applied to either of the larger articulations of the upper extremity. In the former we entertain no hope, and we make no effort to retain motion. Perfect junction of the opposite bones is the great desideratum, with a view to re-establish the functions of the limb as a pillar of support, and an agent of locomotion. Whereas, in operations on lesser joints, and especially of the elbow, having no weight to sustain, and of lighter construction, we at least hope for mobility, in however limited a degree it may be recovered.

## THE SHOULDER-JOINT.

Excision of this joint was first performed in the year 1768, by Mr. White of Manchester, and was repeated by several English surgeons, within the following twenty years. Whether from want of enterprise in the surgical profession, or from the want of opportunity, the operation fell into abeyance, until it was again resorted to by Mr. Syme, in whose hands it proved eminently successful. It has now become an operation established by general approval.

Indications.

Excision of the head of the humerus, rather than that of the shoulder joint,—for the glenoid cavity is rarely involved to such an extent as to require its removal,—is resorted to in cases of incurable disease of the articulation, in severe injuries sustained by the joint, as in gun-shot and other wounds, and occasionally in compound dislocations. Disease of the joint is characterised by protracted pain in the region of the articulation, often originating in that of the insertion of the deltoid muscle. The movements of the limb have long been greatly abridged in extent, while any attempt either to raise or to rotate the bone is attended with pain, both severe and continued. The deltoid muscle has become atrophied by reason of its totally suspended office, the shoulder is flattened, and the constitutional health generally and greatly impaired. This condition of the joint would probably have originated in simple sinovial disease, which has become intractable and advanced towards the disorganisation of the structures through the partial or complete absorption of the arthrodial cartilage covering both the head of the humerus and the glenoid cavity. Matter may have formed within the articulation, and have found its way to the surface through one or more sinuous channels.

In other examples both the nature and the progress of the diseased action are less severe, the destructive inflammation is more chronic, while the movements of the limb are not more free. The joint appears to have wasted, and the shoulder to have become more flattened in comparison with the opposite joint than occurs in the former example. But the joint is destroyed for all the purposes of motion, and the functions of the deltoid muscle are abrogated for ever. In the case of gun-shot wounds which have either perforated the head of the bone, or have passed through the joint, the experience of such injuries received in battle proves the certainty of destructive actions being thereby initiated, as will infallibly terminate in the disorganisation of the joint. In such cases, therefore, judicious surgery appeals to the operation of excision as the valuable alternative to the loss of the entire limb. In such a case the necessity for the removal of the glenoid cavity, either partially or completely, will depend on the condition of the bone when exposed to view. If shattered or even if fractured, inasmuch as that process of the scapula can perform no very useful part in the future economy of the limb, it should be at once removed.

The excision of the head of the humerus may be also required in cases of necrosis. It should be recollected that necrosis is especially a disease of the bone, and not of the joint; and it is a remarkable fact in the pathology of bone, how large may be the extent of disease of the shaft of a bone without its involving the structures of a contiguous joint. Notwithstanding the liabilities to disease of various kinds which appertain to joints, these regions possess a remarkable immunity from disease, extrinsic though contiguous to them, whether of bony or other tissues, and in no form in which disease presents itself in the neighbourhood of joints is this feature more striking than in that of necrosis. This barrier raised in defence of the joint in the case of necrosis, may be assigned to the fact, that necrosis of bone rarely extends to the expanded extremities, but is usually limited to the shaft of the affected bone. I do not recollect in the large number of examples of diseased bone on which I have operated, I have ever had occasion to approach the joint itself, whereas, I can bear testimony to the existence of many varieties of growth, both simple and malignant, in the neighbourhood of large joints in which the articulation has been left intact.

Let us not hastily infer the implication of the shoulder-joint because its movements are limited in extent, or are effected with pain and difficulty. A bone diseased to within an inch of its articular surface may explain these and even greater difficulties.

Necrosis of the humerus is indicated by general swelling of the deltoid region, and is usually accompanied by the presence of one or more sinuses leading down through the substance of the deltoid muscle to dead bone. Should the probe pass into the interior of the shaft, the evidence is yet more conclusive. The extent of the dead bone may be inferred from the condition of the structures around, from the number of the sinuses communicating with the bone, and the character and appearance of their orifices in the skin, and from the duration of the disease.

This history does not warrant an operation of excision of the head of the bone, simply because there is no evidence to bear out disease of that portion of the humerus. Careful discrimination will probably determine the necessity of exposing the shaft of the bone below the articulation, and of extending the incision upwards to the joint, conditionally only on the extension of the diseased actions in that direction. Assuredly, necrosis of the humerus does not afford a frequent warrant for the operation of excision of the head of the bone.

Operations.

The operation originally adopted by Mr. White consisted of a straight incision carried downwards from the acromion through the deltoid muscle to the extent of five or six inches. Some difficulty was probably experienced by the retention of the head of the bone by the tendon of the biceps muscle. To remedy this evil, Professor Langenbeck commenced his incision forwards over the bicipital groove, and detached the tendon by dividing the fibrous sheath that fixes it to the bone. The joint is exposed by the upper surface of the capsule being divided transversely as well as longitudinally, the head is disarticulated by being pushed through the divided parts, and sawn off to any extent required. This necessity is of course gauged by the extent of its disease, but if it be deemed advantageous to remove any portion beyond about an inch below the head, either a partial or a complete division of the muscles inserted into the bicipital groove becomes necessary.

For the second mode of exposing the head of this bone we are indebted to M. Stromeyer, who adopted a circular incision, commencing below the spine of the scapula about two inches behind the acromion, and carried downwards to about the middle of the length of the deltoid muscle, and thus sweeping round and terminating about an inch on the inner side of the acromion process. This incision may at once extend in depth sufficient to divide the muscle. The flap being raised exposes the exterior of the joint and the head of the bone is thrust through a free opening made into it by the knife.

In sawing off the bone, the arm should be brought forwards to the anterior surface of the patient's body, in order to place the projecting head at a convenient angle for the application of the saw, the soft structures around being protected from injury by a flat piece of metal placed behind the bone, and, at the same time, great care should be bestowed in this and in all cases of the kind, to the end of preventing the healing process being protracted by the presence of saw-dust in the wound. The advantage attributed by Stromeyer to this method of exposing the head of the bone consists in the facility given for the escape of the secretion, from the interior of the wound, by which the healing process is assisted. The permanent injury done to the deltoid is perhaps neither considerable nor important, because sufficient power remains to it to effect the required movements of the arm, which, however successful the operation, must of necessity be limited. It has also the advantage of exposing the bone more freely to manipulation, an object of some moment where the removal of a considerable portion of the shaft is desirable.

Of the two operations, that of Mr. White has the merit of greater simplicity, and it obviates one great defect in all operations, viz., that of the unnecessary division of muscular fibre; and there can be little doubt that, in respect to the question of hæmorrhage, the advantage is also in favour of the straight incision—an argument that would weigh but lightly in the estimate of M. Stromeyer, who clings to the good old doctrine of copious local depletion as an essential part of the after treatment. M. Stromeyer was somewhat unfortunate in the loss of several of his cases by pyemia.

When the bone is removed the parts should be replaced as much as possible in their natural position, the arteries tied, and all hæmorrhage arrested, the edges of the outer wound brought carefully into contact, the fore-arm raised and supported in a well-adapted sling, elevated to a height proportioned to the length of the bone removed.

The great object is that of obliterating the cavity within, as much as possible. The sawn extremity of the bone should be raised upwards to the level of the former socket, and general pressure from without maintained by means of a large quantity of cotton wool, over which a roller may be applied in such manner as to afford support to the joint and bring all its structures in a normal relation to each other. If this object be accomplished, and the health of the patient maintained by the administration of such remedies as will protect him from the consequences of the shock of the operation (and for which I must refer the reader to the subject of the after treatment of operations), we have no reason to doubt a favourable issue of the case. At the expiration of from three to four weeks the arm may be subjected to slight passive motion, to be increased both as to extent and duration day by day, and if unattended with pain or with increase of discharge from the wound, we may anticipate for our patient a useful degree of movement hereafter to the affected limb.

## THE ELBOW-JOINT.

No joint in the body, judging from past experience, obtains more substantial advantages from the operation of excision, than the elbow-joint. This success is due, doubtless, to its less critical nature in the economy of the body, both as regards its relative size, and not less so to the superficial relation of the bones composing it, to the surface of the body. The concurrence of these two features, but more especially the facility of its exposure, has brought it within the range of experimental treatment more frequently than any other joint. As regards the functions of the arm, the elbow may be said to be a more important joint than the shoulder itself. The movements of the shoulder relate to surrounding objects. These relations may be obtained by change of position of the body, while many of the most important movements of the elbow refer to the trunk itself; and in case of disease or mutilation it has no representative. In disease of the shoulder the fore-arm retains much of its utility in the economy; while in that of the elbow-joint, the offices of the entire limb are more or less abrogated.

Indications. It is remarkable to what a great extent the utility of the upper extremity is reduced in cases of permanent rigidity of the elbow-joint in the straight position. The functions of the limb are restricted to its relation to objects at the radius of the arm only, while its services are almost entirely lost to the person. As compared, therefore, with the last-named joint, in addition to disease and injury, the condition justifying excision of the head of the humerus, a third condition, that of anchylosis, may be added for the consideration of the surgeon, because the aim of surgery points to the relief of impaired functions, and a straight inflexible limb is incompatible with the large majority of such actions as the arm is destined by nature to perform. If, therefore, the question of danger can be met by a satisfactory reply, and more especially if the occupations of the individual man are such as to demand an altered relation between the hand and the trunk, many of the offices of the arm being performed at the focal distance of his vision, we are justified in the attempt to remove the evil by operation. If under these circumstances, then, such a case present itself, the surgeon has a full warrant on sound surgical principles in contemplating the operation of excision of the anchylosed bones.

About the year 1780 excision of the elbow-joint was performed by Mr. Park. It was repeated by many surgeons, both British and Continental; and, after an interval of nearly half a century, during which few records remain of its performance, it was again brought under the notice of the profession by Mr. Syme, who practised it on many occasions with remarkable success. Excision of the elbow-joint, or of one or more bones entering into its composition, may be resorted to in *disease* of the articulation, leading to abscess in the joint, absorption of cartilage, and partial dislocation consequent on separation of the ligamentous textures. Of the various grounds justifying the resort to the operation that of disease demands the most careful diagnosis. During the active stage of diseased actions of the joint, the operation is scarcely admissible. We wait for the cessation of pain and heat, and other indications of active disease. This object attained, we yet hesitate lest we now interrupt the natural process of anchylosis, and the more so, provided the joint has assumed the angle most subservient to the functions of the fore-arm and hand. To this crisis Nature will carry the disease under the favourable condition of a gradually subsiding inflammatory action. We therefore hesitate in our proceeding, until we obtain good evidence from frequently recurring pain, and increased swelling of the joint, that active disease, although at present dormant, is yet lurking within. We are scarcely ever justified in the operation of excision, either of this or of any joint during the stage of active disease. The indications of local pain, and increased heat of the integuments around the joint, may be deemed, except under particular conditions, fatal to the resort to the knife. Disease of the bones forming the joint is not a frequent cause justifying the operation, for reasons previously given. Such disease, in the form of necrosis, does not commonly reach the joint, but appears instinctively to avoid it, while the carious or softened condition of the bone may be the concomitant of disease of the general structure of the articulation.

Excision of the elbow-joint is occasionally demanded in cases of injury, whether in the form of irreducible dislocation, compound fracture, or as practised largely in military surgery of gun-shot wounds. Its application to irreducible compound fracture is necessarily rare, because it is preferable to make any reasonable division of the soft parts, for the purpose of replacing the exposed or protruded bone, and thereby giving the joint the chance of restoration, to the certain issue of impaired movements, and probably of anchylosis, by its immediate excision. Still such cases do occur, and should be met by decision.

Its application to necrosis of the bones is also rare, for reasons given above. The operation for necrosis and that for excision are totally distinct operations. In the case of gun-shot wounds, excision is a valuable resource; and the more so, because it would appear from the evidence of military surgeons, and especially of Langenbeck and Stromeyer, that the elbow joint is especially liable to injury: 1st, from its exposure; and 2nd, from the tendency of the humerus to split downwards into the joint. One does not quite comprehend the peculiar liability of this portion of the frame to musket wounds—at least the liability is not protective of other parts, or the frequent splintering of the humerus could not be assigned as a prominent motive for the operation.

"The object of this operation is to restore, if possible, a thoroughly moveable articulation, such a one as is fitted for all the ordinary avocations of life; but if mobility is unattainable, a firm anchylosis at a suitable angle, is the most desirable result." *

Operations. The excision of the elbow-joint, whether partially or entirely, is made by requisite division of the parts behind; and before proceeding to the operation, it is desirable to form some idea, if possible, of the extent of the disease, and of the particular bone or bones affected, and of its nature. Whether synovial, or whether necrosis, or especially in cases of compound dislocation, we can have little difficulty in forming a tolerably correct opinion on this subject. The joint is exposed by either one or two longitudinal incisions made on the back of the articulation, varying in length from 3 to 4 inches, according to the size of the morbid structures to be removed. It is almost unnecessary to say, that the smaller the exposure of the joint, compatible with the sufficiently free command over the diseased parts to be removed, the better. Mr. Syme's operation, which has perhaps been most generally adopted, consists of two longitudinal incisions, of 3 to 4 inches in length, made more than an inch asunder along the posterior aspect of the joint, and connected by a transverse line, made immediately above the olecranon. Thus, two flaps are formed in size sufficient to freely expose the articulation, care being taken in reflecting the inner portions to protect the ulnar nerve from injury, the close proximity of which to the inner condyle and olecranon is known to every anatomist. These flaps, with all the subjacent soft structures, are

---

* British and Foreign Medico-Chirurgical Review, Oct. 1857.

reflected sufficiently to expose the bony fabric of the joint.

In order to avoid the evils attendant on the unnecessary exposure of the articulation, Langenbeck has adopted a single longitudinal incision made about one-third from the inner condyle, and of course on the outer side of the ulnar nerve. Experience has proved this incision insufficient for such complete exposure of the joint as is required in the operation. The necessary drag on the integuments towards the outer condyle has been attended with their laceration. This evil led to the adoption by Mr. Liston of a second incision, made transversely outwards across the back of the joint, and commencing from the middle of that first made. The two flaps are reflected outwards from the back of the joint; and all the textures capable of separation are removed from the bones on the inner side, including the ulnar nerve, which should retain its undisturbed position in its cellular sheath. The articulation being opened, the lateral ligaments are divided, and the joint disarticulated, by bending the forearm, and pushing the bones backwards through the opening thus made. Nothing remains but the removal of the bone, which should be effected with peculiar care in this as in every example of excision of joints. The soft parts are protected from injury by means of a piece of flat metal employed for the purpose, and placed behind the bone to be removed. This last stage is completed by means of a small fine open saw. If the operation has been undertaken for synovial disease of the joint, the removal of the articular ends of two lesser bones will probably suffice. In other examples, the articular surface of the humerus may be removed, and the acknowledged fact that the excision of one portion of the bony structure of the joint is compatible with the restoration of a useful limb, might raise the question, whether the cavity of the joint being now destroyed by its complete exposure, the same object may not be attained by leaving the bones intact, presuming them of course to be in a healthy condition. I am strongly inclined to think that future experience may justify the suggestion I now make. When necessarily undertaken in cases of irreducible compound fracture, rare as such cases must be, the protruded bone determines for itself the extent of the required removal.

In anchylosis, the removal of bone answers no farther object than that of effecting motion with a view to alter the angle of the future joint, and we select that portion of the continuous line of bone most readily divided. On all accounts the locality of the former joint would be selected for that purpose, because we may yet hope for movement in some form or degree; and it is always desirable in every operation of excision on this joint, to retain if possible the services of the muscles engaged in flexion and extension. If it be deemed necessary to excise the coronoid process of the ulna, the insertion of the biceps into the tubercle of the radius may yet be retained.

In other forms of disease or injury in which the bones themselves are involved, we have no rule by which to determine the extent of the division of the bone. The amount of disease must always remain more or less uncertain until the region is explored, while in cases of fracture, as in gun-shot wounds, the retention of any fragments of separated bone would appear incompatible with recovery. The experience of military surgeons points to the necessity of exploring a joint severely injured by a musket or rifle ball. This is a far more severe and dangerous injury than that of compound fracture extending into a joint. We know this latter injury to be compatible with the restoration of free movements of the joints, while the future liability to destructive actions in the case of a severe gun-shot wound holds an inverse ratio with the slightness of the injury apparently done at the moment. In such a case no absolute rule can be laid down for the guidance of the surgeon. The joint must be exposed, all disorganised or damaged parts carefully removed, and the bones placed at such an angle as may ensure the greatest amount of future utility to the limb. The bones are to be placed in easy contact with each other, and not urged into close contiguity.

The diseased parts being removed, the wound is then closed, a small dependent opening being left for the escape of discharge, the elbow is bent and laid on a splint curved at an angle of about 120°, and the utmost quietude maintained until the outer wounds are entirely and firmly healed. At the expiration of from four to five weeks, at an earlier period in some cases, and especially in young persons, but later in others, *slight* movement of the joint may be made in flexion and extension. Its repetition may be made from day to day, dependent on the absence or presence of pain and other indications of local irritation which will give palpable evidence of the ultimate issue, whether in a moveable joint or in permanent anchylosis. However desirable it may be to retain power of flexion, we possess no curative power by which to acquire it. Our only remedial means consist in avoiding the causes of local irritation, promoting health and passive motion.

## THE WRIST-JOINT.

Excision of this joint has been undertaken on many occasions for disease of the articulation deemed incurable. The results obtained from past experience of this, do not justify the hope that it will ever command the ultimate success that attends on the last operation, and on every ground it should only be undertaken on the most careful diagnosis.

**Objections.**

Three objections to its frequent performance present themselves to the observation of the surgeon, either one of which is a source of difficulty and embarrassment:—1st, the complicated structure of the joint, which in its integrity involves three distinct articulations, viz., that between the radius and the ulna, that between the bones of the fore-arm and those of the carpus, and, lastly, the articulation between the carpal and their articulation with the metacarpal bones. 2nd, the uncertainty of the extent of the disease, whether involving the bones forming the first, second, or third articulations; and 3rd, the difficulty of exposing the diseased structures without more or less injury to the numerous tendons placed around. In irreducible compound dislocation there is less difficulty, because the operation consists merely in excision of protruded bone, the removal of which by the saw has become a matter of necessity. The operation of excision may be performed in various modes:—1st, by two lateral incisions, each following, longitudinally, the line of the respective bones. In cases in which disease is confined to the articular ends of the radius and ulna this method of obtaining access to them is, perhaps, the least objectionable; but if it be proposed to excise the carpal bone also, it is obvious that the radial incision will involve the articulation of the metacarpal bone of the thumb with the trapezium, a proceeding justly reprobated by Mr. Butcher. 2ndly, by two longitudinal incisions made in the middle of the carpus--one in front, the other behind. The objection to this method consists in the large exposure and probable division of soft parts. 3rd, by a posterior flap made on the carpus—which involves more or less the extensor tendons of the fingers. This flap, as recommended by Mr. Butcher with a view to preserve unimpaired the articulation of the thumb, commences behind the lower end of the radius on the ulnar side of the last extensor of the thumb, and is carried across the wrist in an arched form to the extent of about three inches. By this incision the extensor tendons of the fingers are also divided—an evil of great magnitude and to be avoided if possible, because muscles that have lost antagonism waste and become useless. If the extensors of the fingers are destroyed, the flexor muscles, having no longer any antagonism, gradually close the hand in permanent flexion, and its functions as regards the fingers are destroyed for ever.

In a case I recently had in St. Bartholomew's Hospital the entire mass of extending power was destroyed by machinery, excepting the extensor muscles of the thumb and a small part of the extensors of the fingers. By this means a kind of antagonism is retained by which the action of the flexors and with them the functions of the fingers is restored. By either one of the above incisions the difficulty of applying the saw is very great, while the imperfect view of the diseased parts obtained by the lateral incisions almost precludes the removal of such structures only as are really diseased. In carious affections of the carpus demanding operation I prefer to make a posterior flap, commencing over the carpal attachment of the index finger and carried round in an arched form, ending above the styloid process of the ulna and to its mesial side. This flap divides integuments only. The tendons of the common extensor may be separated by a longitudinal incision and drawn asunder with a blunt hook to either side. The remainder of the operation may be undertaken with a pair of either straight or curved parrot-bill forceps, by the agency of which all the dead bone may be removed without the aid of the saw. It will probably be found on examination that two or three of the carpal bones only are affected. Mr. Jones informs me that he has, in a case of strumous disease, successfully removed the entire of the carpal and the articular ends of the four metacarpal bones, including the lower extremity of the radius in a female who retained a useful though mutilated hand, and in a second case also he excised the entire carpus with the articular ends of the radius with a similar result. After the operation the tendons, to which as little violence as possible should be done, great care being taken not to injure unnecessarily their cellular sheath, should be replaced in their normal position and the wound in the skin united by plaster. The hand is placed on a splint, and passive motion attempted in the course of from ten days to a fortnight. If the tendons have been denuded of their cellular sheath they are very liable to become united to the integuments covering them.

## THE HIP-JOINT.

This operation, like that resorted to in disease or injury of the shoulder-joint, consists in partial excision only, in other words, the removal of the head, and a portion of the neck of the femur, the acetabulum being left entire.

Indications.

In cases of gun-shot wounds, or other forms of severe fracture of the joint, justifying the operation of excision, we can readily imagine splintered portions of the pelvic half of the articulation to require removal, but on no other conditions would it appear warrantable to attempt the separation of any part of the acetabulum. If the disease for which it is undertaken be malignant in character, it is obvious that no attempt at removal of this bone can be successful in restoring health, and the operation itself is to be deprecated.

In sinovial disease, whether in this or in other joints, the removal of one half of the articulation will suffice to arrest the morbid actions, and it is not found by retaining the cartilage lining the acetabulum with its diseased investment of sinovial membrane, that any serious obstacle to recovery results.

In protracted diseases of the entire joint the bony socket of the pelvis must be almost necessarily involved. If the bone be the seat of necrosis, unless the dead portion be loose, or nearly so, it can hardly be reached by any form of safe manipulation. Neither cutting, filing, nor scraping the bony surface will suffice, and one can scarcely comprehend the advantage proposed by the application of the actual cautery as practised in the school of Germany. I quite agree, however, with Mr. Hancock * in deeming the presence of disease in the acetabulum to present no obstacle to the operation of excision, if otherwise demanded by the necessities of the case. While in the old hip disease of young persons, in which the partially absorbed head of the femur has been long dislocated, any interference with the structure of the acetabulum is quite uncalled for. In military surgery, the excision of the head of the femur has occasionally proved a valuable substitute for amputation of the limb. But by this alternative we merely select the lesser danger of excision in preference to the greater one of amputation.

Amputation at the hip-joint is for the most part a fatal operation. Excision of the head of the femur, however formidable, has succeeded in the proportion of something less than half the cases operated on in arresting disease and restoring a useful limb.

Operation.

The operation is performed by making a straight incision, beginning below the anterior superior spine of the ilium, and carrying it down upon the trochanter major. If requisite, a second incision in length from one to two inches may be made from the middle of the first in either direction. Beneath the skin the incision would pass onwards between the tensor fasciæ femoris and the iliacus internus muscles, the space between them being separated by the finger, while the limb if practicable, is elevated by an assistant, the capsule of the joint is then exposed and divided. If the ligamentum teres remain entire, it may be divided by a curved bladed knife, and the knee being now carried across the opposite thigh, or greatly adducted, the head of the bone will be drawn out from the socket, and will protrude through the outer wound. The head of the bone is now sawn off, and the parts restored. A second method of reaching

---

* Lancet, 1857.

the head of the femur has been adopted by means of a flap of the integuments and subjacent tissues, commencing immediately below the anterior superior spine of the ilium, directed downwards and inwards below Poupart's ligament, and then carried backwards over the trochanter. This flap includes the integuments only, the division of the deeper structures being common to the two operations. I am not aware that it possesses any advantages to warrant the deviation from the simpler incision.

When the morbid structure is removed, the outer wound is united, leaving a small space for the escape of purulent secretions, and the limb may be retained in a fixed position by means of a well-adjusted long splint, in the application of which we must recollect that no object is attained by employing it as an agent of extension.

It would appear that perfect rest of the muscular system of the limb is best attained with the limb slightly flexed, a position therefore incompatible with the application of a long straight splint. To effect this object, the thigh should be somewhat raised over an inclined plane, a position which will supply another indication, viz. that of obtaining a dependent aperture for the escape of matter, &c., as well as ensuring a relation of the thigh bone to the pelvis in case of anchylosis, most favourable to progression.

## THE KNEE-JOINT.

If excision or resection of the knee-joint could be divested of its danger, it would stand forth as one of the most brilliant discoveries of modern surgery. This brilliancy, however, pales not a little on consideration of the large mortality that has marked the progress of this conservative operation, an operation admirable in the boldness of its design, and not less so in its consequences, and nothing but a more general success is required to justify the high commendation bestowed upon it, and the remarkable notoriety it has hitherto acquired throughout the surgical world. Mr. Butcher gives in a statistical report, a proportion of 26 per cent. of failures, obtained from a catalogue of 82 cases, and at the time he writes, February 1857, gives a list of 21 out of 57 cases, in progress towards recovery! Mr. Humphrey of

Cambridge, in a catalogue of 13 previously unrecorded cases, acknowledges the failure of the operation, whether by the resort to amputation of the limb or by death, in 5 cases, a failure equivalent to upwards of 35 per cent. These facts are well worthy of observation, not as necessarily exercising a deterring influence on the operation, but which should be placed in the foreground as a warning to inexperienced men. In the small island of Jersey, the balance in favour of success has been restored by Mr. Jones, who in a catalogue of 14 cases of excision of this joint, has succeeded in recovering a useful limb in no less than 13, the fourteenth patient having died of dysentery. It would perhaps be hardly reasonable to attribute these very different results to the exercise of a higher manipulative skill in the performance of the operation, neither can they be fairly attributed to local causes, whatever be the merit of the Jersey climate, nor to the healthier constitutions of the subjects of the operation. We are driven then to the alternative of after-treatment as the only remaining but obvious explanation of results so dissimilar, and on this head Mr. Jones remarks as follows : " I attribute the large amount of success that has attended my cases partly to climate, and partly to *stimulating* after-treatment, certainly to no particular dexterity that I possess, nor can I fail to attach some weight to the fact that I trust to my own hands alone for the entire of the mechanical treatment."

The operation of excision of the knee-joint was first performed by Mr. Filkin of Norwich in the year 1762, and in 1781, by Mr. Park. The records of British surgery make no mention of other examples until it was undertaken by Sir P. Crampton, and again by Mr. Syme early in this century. Since the year 1850, it has been performed repeatedly by many eminent surgeons both British and foreign, the two who have contributed most liberally to an abundant catalogue of cases are Mr. Fergusson and Mr. Jones, to the former of whom the profession is more especially indebted for his resort to the operation after the long period during which it had been in abeyance.

Indications. The operation is practised as in other examples of excision of joints, in diseases of the articulation deemed incurable. Under this term is included permanent disorganisation of either sinovial membrane, cartilage, or bone, but more especially to the two former. In affections of the bones primarily diseased, our operative efforts are directed on the bone itself, and not on the joint, which will probably not be involved in the disease of the osseous framework (*See* NECROSIS). Whereas in diseases of the joint, properly so speaking, the bone is rarely involved to a considerable extent, and the main object of its partial removal, rather relates to the diseased condition of the sinovial membrane and cartilage investing it. Relief by some means must be obtained to a joint the seat of incessant pain, which has undermined the health, destroyed the appetite, and impaired in a greater or less degree every function of the body. If we fail in relief, exhaustion of the vital powers follows, and we have no alternative but death.

*Presuming every curative agent to have been tried* without benefit, every palliative exhausted, we have three alternatives before us, to one or other of which we must resort — 1st, opening of the joint; 2nd, excision; 3rd, amputation.

With regard to the first of these measures; it is especially called for in cases, not very uncommon, marked by more than ordinarily rapid progress in which the cavity of the articulation is distended with matter. In such examples we have no outlet for its escape by means of sinuses—the fluid is penned up within the unbroken membrane. The cavity should be explored, first by a limited, and, if necessary, by a free incision made into it with a scalpel. The outer side of the patella is the most suitable locality for such an incision. If the structure of the joint be disorganised, the aperture should be sufficiently large to permit the ready escape of the contents of the morbid membrane; and the drain thus made will often and at once give permanent relief to weeks of suffering, and lead the way to the ultimate crisis in anchylosis. Hæmorrhage is of secondary moment. The most timid operator may make this division without fear or hesitation. I would go farther, and express my belief that a free incision into the knee-joint even in most chronic examples of disease, especially if they afford evidence of the presence of penned-up fluid within the joint, will be followed by relief in a very positive degree, and sufficiently so often to render the minor operation of puncture a permanent substitute for the major one of excision.

A condition of the knee-joint denoting its advance towards disorganisation, or having reached that crisis, essentially chronic in its character—free from severe pain or great heat, incapable of sustaining the weight of the body, either at rest or in progression; and the previous treatment of which has exhausted all the resources of surgical skill, such a condition raises the question of permanent relief by the removal of structure fatal to physical exertion and injurious to health. For such a disease, or rather for such symptoms from whatever benign disease of the joint they may arise, the operation of excision is proposed and undertaken. The justification of resection of the knee is not found in its avoidance of danger to life. As compared with amputation of the limb, it is doubtful whether the one or the other operation possesses the greater immunity. There are not wanting eminent members of our profession who claim for amputation a lesser amount of danger of the two operations; but excision is preferred, because, if successful, it restores a useful and living member to the body in the place of an artificial and necessarily an imperfect one; and this feature, and this only, gives it a warrant to be classed under the title of "conservative surgery."

Operation. The operation is performed by exposing the cavity of the joint in front. This object is effected either 1st, by two lateral incisions made parallel to and in front of the lateral ligaments, extended to the length of from four to five inches or longer, and united by a transverse division across the ligament below the patella; or 2ndly, by a semi-lunar or rather a curved flap commencing about two inches above the patella on either side, and carried downwards, first in the axis of the limb, and then across the joint below the patella, and upwards to a corresponding line on the opposite side. The first of these two forms is that more generally adopted. The line of incision presents a form somewhat resembling the letter H. The parallel lines are carried down to the bones, each in front of the corresponding lateral ligament along the entire length of the incision, the transverse one divides as completely the ligamentum patellæ about half, or three quarters of an inch below the bone, and the joint is freely opened by raising the upper flap. In this flap is imbedded the patella. Whatever may remain of the crucial ligaments is next divided, and for this purpose the knee is slightly bent. The lateral ligaments follow, and the back of the joint is freed from its attachments to the posterior ligament, and any other fibrous structure about the bones, to an extent somewhat greater than the corresponding portions of bones to be removed.

The limb is now bent at right angles, and the condyles are sawn off with as little violence as possible. It would appear to answer the indications previously laid down for this and other operations of excision, that the removal of the cartilaginous surfaces was sufficient. But in this example more is required. When the knee is bent, the flexor muscles acting on the leg without antagonism, tend to draw the tibia backwards; and it is often extremely difficult to obtain apposition of the divided bones unless one or two inches of the femur are removed. Wherever the saw is employed it should be applied with peculiar care and lightness of hand, and it is of the highest importance that the incision through the bone be made in an exactly transverse line, and quite vertical through either the condyles or shaft whichever point is selected. The articular surface of the tibia is also cut clean in a line perfectly transverse to the long axis of the bone, of which the removal of the entire cartilaginous surface is all that is required.

It must be desirable in the excision of all joints resulting in anchylosis, to retain as large surfaces as possible for the union of bone. Unless, therefore, some obstacle presents itself during the operation, whether of mechanical difficulty or of morbid structure, demanding a division of the femur above the condyle, it is preferable to remove the condyles only, and retain the expanding shaft of the bone immediately above them. By this division the cut surfaces will present some correspondence in form to each other, and the limb is abridged of its length to an extent just sufficient to compensate for the loss of movement at the knee. Unless the length of the limb be somewhat reduced, the future movements in progression will be rendered both irksome and unsightly.

A modification of the operation consists in the removal of the patella, which has been more recently recommended by Mr. Fergusson, and in contemplating the future form and attributes of the joint it would be difficult to assign to this bone any useful function in its economy—the only objection to its removal being that of rendering the operation somewhat more complex, and of leaving behind on the anterior part of the joint a thinner covering than one would prefer to have. Mr. Jones has proposed to retain not only the patella, but the ligament connecting it to the tibia. In order to effect this, he draws aside the ligament as soon as the joint is exposed, bending the knee in extreme flexion, and removes the articular surface of the tibia by means of the open saw. It is no doubt desirable to retain the integrity of the quadriceps muscle, and especially of the rectus if possible.

By the action of these muscles the leg is brought forwards in progression, and raised on the trunk in the horizontal or semi-recumbent posture. They have highly important functions in the economy of muscular action, and it is a great object to retain them, provided the attempt does not compromise the main object of the undertaking, that of ensuring recovery; for although the division of the tendinous insertion of the rectus muscle would incapacitate it, and the remaining extensors for their larger functions hereafter, and for which indeed they are no longer required, still the new adhesions they would certainly acquire, even though their natural insertion be destroyed, will always render the rectus muscle at least a valuable contributor to the movements of the limb.

The latter stages of the operation are greatly facilitated by the division of the ham-string muscles. The enormous power of the three large flexors occasionally exercises a most prejudicial influence on the best efforts to place and retain the bones in apposition. I have known this power brought into sudden and uncontrolled play some days after the performance of a well-completed operation: the limb bent in forcible flexion, the outer wound torn asunder, and the joint exposed. The consequences were threefold, — irritation, amputation, death. The cause consisted simply in an injudicious attempt to change the splint before the bones were united. To meet this difficulty it might be advisable to commence the operation by neutralising the power of the muscles by dividing them as suggested by Mr. Hutchinson. When the morbid parts are entirely removed the bones are adjusted, and all the soft parts, especially the integuments, carefully replaced in their position of rest, — the leg brought into a straight line, and retained by means which exercise as little strain as possible on the limb. In other words, every part should be thoroughly well adjusted, *and the absence of movement however trivial most carefully avoided.* This very important end is best attained by the employment of the splint which has been perfected by Mr. Lawson, of the Great Northern Hospital, made by Matthews, of Portugal Street, and also by Ferguson of St. Bartholomew's Hospital.

We have now to contend against the slow but almost certain influence of suppuration more or less profuse, and the protracted, and occasionally fatal, exhaustion consequent upon it. It is truly observed with respect to excision of the knee, and probably with resections in general, that the shock to the system is less severe than in removal of the limb. This is a fact in the management of any given case of considerable moment, and its due weight should be thrown into the scale in favour of excision. By the absence of "shock" we obtain at least time for deliberation. In the practice of Mr. Jones, of Jersey, it would appear that neither the one nor the other evil prevailed in any but a slight degree. These tendencies will be best averted by the most gentle unirritating local management, and by the bold administration of stimulants from the hour of the operation. No movement of any description should be permitted between the bones until after the lapse of several weeks, or until the union between them is complete.

## THE ANCLE-JOINT.

This joint has been frequently the subject of excision, whether partial or entire. It was first adopted by Moreau, in France, in cases of severe compound dislocations of the foot, for which it is especially suited. The form and construction of the joint, the limited extent of its natural movements, and its relation to the numerous tendons surrounding it on all sides, render it the more frequent seat of irreducible dislocation than any other joint in the body, while it shares with other joints the common liability to sinovial disease and its consequences. Excision of the lower extremity of the tibia in dislocation found a powerful advocate in Sir Astley Cooper, who adopted it on many occasions, and with great success. The operation as practised by Sir A. Cooper, consisted in the removal by the saw of any protruded bone or bones which prevented the restoration of the foot to its normal position. This he effected irrespective of the consideration of future mobility, rightly inferring that a stiff joint and a sound foot were preferable to an amputated limb, but experience taught him that the replacement of the sawn end of the tibia upon the uninjured articular surface of the astragalus was not incompatible with future limited motion of the joint, a fact of which we have abundant examples both in this and in other articulations.

Prior to the employment of the saw there is a middle course worthy of adoption in cases of irreducible dislocation, viz., a careful survey of the mechanical impediments to the replacement of the bone for the purpose of division. The cause of sound surgery has been greatly served of late years by the introduction of subcutaneous division of parts whether of tendon, of ligament, or other fibrous tissues. This principle should be freely resorted to in the cases of dislocation. Any and every ligament, and almost every tendon may be divided in the reasonable hope of their reunion, provided they are covered with an ample supply of integument, prior to the removal of the articular ends of the bone. The excuse for removal is, however, more generally found in the locking of the joint, by the contraction of the muscles of the leg, but even here relief may be obtained by the division of the tendons around.

For the excision of bone in dislocation of the foot the operation will be modified by the nature and amount of injury done. All that is required is the sawing off of just so much of the articular end of the tibia as will enable the surgeon to replace the protruded bone in such a form as to adapt it to the surface of the astragalus below. The tibia therefore should be sawn straight across at right angles to the shaft. For this purpose the wound in the integuments may require to be enlarged. If broken or comminuted bone remain behind, it should be carefully removed. If the fibula be broken above the ancle-joint at the usual seat of fracture in dislocations of the foot outwards, unless it be considerably separated from the parts around, it may be replaced. Its articulation with the astragalus will always afford an additional element of strength to the new articulation. If, however, the section of the tibia extend beyond its articular surface, the fibula must undergo the same division.

In diseases of the ancle-joint involving all the articular surfaces the practice of removing a portion of both tibia and astragalus has been very commonly adopted, but I cannot help believing without ample reason to justify it. We have abundant evidence of the fact, that the entire exposure of a joint and the excision of one-half of the articular surface will suffice to restore not merely the limb to usefulness but often the joint to motion; and the required movements of the ancle-joint in health are so limited that every opportunity should be afforded it to regain this power. Unless the disease involve the bony structure of the astragalus the attempt should, I conceive, be made to retain it. We may rest assured that the *vis medicatrix* will exhibit far more wonderful protective powers in the economy of animal life than is here proposed in the apparently ill-assorted union of cartilage and bone. To retain a part of a joint from which one half only has been removed is to dispossess the operation of a part of its objections. In the case of the ancle-joint it is very true that by the attempt to retain the astragalus entire we leave behind two surfaces mechanically ill-adapted to each other; but such a relation between articular bones where we desire to retain mobility has proved itself, on many occasions, remarkably successful, and I know of no case of excision which has failed of recovery in consequence of such retention. Whatever be the changes of form or structure that these surfaces undergo, whether the tibia be rounded off and condensed in texture by the deposit of new bone and the astragalus denuded of its cartilage, certain it is that the mechanism around the joint, whether under the form of ligament or of general fibrous tissue, is sufficiently perfected to resume its primary office of retaining the opposite surfaces of the bones in close contact. Under these circumstances it would appear that the less the derangement of parts within the joint the better, both as regards the present and the future.

Operation.

The excision of the ancle-joint may be performed by exposure of the cavity either in front or on the inner side. By the latter incision we meet with less difficulty from the presence of tendons, while by the former the joint can be more fully exposed to the action of the saw. On the other hand, the anterior section involves the almost necessary division of the tendons of the tibialis anticus and extensor muscles of the toes. The inner operation is performed by a flap of the integuments, commenced in front of, and above the malleolus for the right foot and so for the left, close to the tendon of the tibialis anticus, and carried downwards sweeping round the tibia at a distance of from half to three-quarters of an inch below it, and extending upwards and backwards nearly to the tendo achillis from two to three inches above its insertion in the os calcis. All the soft parts are divided to the bone. The tendons of the tibialis posticus and flexor of the toes, if healthy, may be drawn backwards and the joint opened. The foot is now dislocated outwards and the lower end of the tibia cleared of the soft parts, investing it to a sufficient extent to command it freely. The articular surface may then be removed by the saw. If the tibia be carious it is probable that the astragalus will have assumed the same condition and the whole of its articular surface should be taken away. The same remark will apply to the fibula.

The anterior flap is more applicable to cases of long standing disease in which the process of disorganisation of the joint and surrounding structures is more advanced. The anterior flap is made by an incision commencing about two inches above the malleolus externus for the right foot and *vice versâ* for the left, and carried round about an inch below the front of the ancle-joint, extending inwards to the back of the inner ancle. The soft structures are all divided, including the lateral ligaments, and the joint is opened in front.

The bone or bones being removed, the opposing surfaces are adapted to each other, the tendons replaced, and the integuments restored to their natural relations.

The limb should be laid on a firm splint adapted to its shape. At the expiration of from four to six weeks, or as early as may be dictated by the absence of local pain, and the healing of the outer wound, the attempt to move the joint may be made with great caution, and continued daily ; but weeks longer should elapse before the weight of the body should be thrown upon the foot, or any attempt made in the nature of locomotion.

## FINGER-JOINTS.

These lesser articulations when the seat either of irreducible compound dislocation, or of destructive inflammation of the joint, present very suitable occasions for the operation of excision. In examples of injury from violence, the end of the protruded bone may be removed by the bone forceps ; and the soft parts restored, some care being bestowed on the careful replacement of both flexor and extensor tendon. The opposite end is left untouched. To remove it, is deemed unnecessary. The result of the removal of the articular surface of one-half the joint is not uncommonly followed by the restoration of limited motion. Yet there is no difference either in structure or in function between the lesser and the larger joints. In examples of sinovial or other disease of the joint, in which the joint is attended with grating of the opposite bony surfaces, and if unaccompanied with local pain, the cartilage will be gradually absorbed ; and the somewhat limited movements of the joint restored with ivory deposit of the articular surfaces, or if retained in a state of perfect immobility by being fixed on a splint, the disease will probably terminate in spontaneous anchylosis. If the attempt at flexion of the joint create pain, and the finger be jarred by the slightest blow, it will be better to excise either one or both bones composing it. For this purpose a flap of the integuments may be made on either side beginning about one-third of an inch above the joint, close to the anterior tendon, and

Operation.

carried downwards to a corresponding point below; the lateral ligament is divided, and the cavity is exposed. One or both articular surfaces of the bones may be removed with the bone forceps. The soft parts are replaced, and a single splint applied to the extremity of the finger by means of plaster. The higher the splint extend up the forearm the better.

Such is the general history and progress of the operation of excision of joints during the last ten years. It is undoubtedly an operation of a higher order of merit, and reflects no small credit on its inventor. The treatment by the excision of a diseased joint, which is followed by the restoration of the limb to utility, is a great feat in surgery, provided it actually supersedes the entire removal of the limb. So long as excision represents or occupies the place of amputation, the operation is worthy our highest approval, and cannot too frequently be resorted to, but a question naturally arises whether amputation of the numerous limbs which have been the subject of this critical treatment was the only alternative to which they were amenable. I will venture to assert that there exists not in the whole catalogue of disease, one requiring more careful and more patient management, more deliberate selection of remedies local and general, and the pathology of which demands a more clear and exact diagnosis than a diseased joint in its advanced stage. This management involves some of the highest principles of a curative surgery, and among these, patience in watching, and perseverance in the endeavour to relieve are the most prominent. If we are bent on curing, we shall generally cure; but a thorough knowledge of the progress of disease in joints, only to be acquired by experience and observation, is the indispensable condition in any and every man before he arrives at the eventful and fashionable crisis of excision of a joint. Is this condition in all strictness observed? Will it be asserted that the numerous operations which have been undertaken for the removal of large joints by excision were the only alternatives to amputation of the limb? When we hear of so many recorded cases of excision of joints operated on by practitioners whose age gives no guarantee for more than a limited experience of the treatment of disease, is it not time to pause and ask, whether all the resources of the art of healing had been resorted to in the previous treatment? Can it be asserted that in not one of these numerous examples was the beautiful process of cure by anchylosis interrupted by the knife? Were *all* the resources of surgery exhausted? Had local depletion, rest, sedatives, pressure, counter-irritants, vapour-bath, constitutional treatment, all failed? Remarkable indeed is the fact, and well worthy of comment, that so large a proportion of these cases of excision have fallen to the share of so comparatively small a number of our professional brethren. Would it appear an invidious question were I to ask of any competitor for surgical fame, who has entered the lists as an active contributor in this cause, what proportion do his cases of excision of joints hold to his cases of cure? Will the most strenuous advocate of excision declare that one case in every five, or six, or ten, or even twenty, reaches its legitimate crisis in excision? If so, let me candidly acknowledge the utter inefficiency of the great hospital of St. Bartholomew's, with its 600 beds, as a school of either relief or instruction in the cause of excision of joints; for with every desire on the part of my able colleagues and myself to resort to it when required by our conviction of the necessity of the case, our great institution has failed to produce but about twelve cases within the last two years. Facts like these are astounding to the ear of those simple-minded persons who imagine we possess a standard of surgery, and that the highest resources of curative art are bestowed in an equal measure among all claimants for surgical relief.

Conservative surgery indeed! Where in the performance of an operation, often of doubtful necessity, at the expense of danger to life, and the fatal issue of which has been no uncommon event,—where lies the principle of conservation? True conservation lies in the substitution of excision of a joint *incurably diseased* for the amputation of the entire limb. This and this only justifies the claim to the title. What guarantee can be given to the profession that such condition has been invariably observed?

I would suggest to the younger members of the surgical profession, that they concentrate their attention on the *curative* agency of surgery; that no local means of allaying pain, or the least indication of disease, be left untried; and that the constitutional powers which often sink from a deficient supply of both nutrients and stimulants most inadequately administered, under the mistaken devotion to a blind faith in the "secretions" and the "digestive organs," be rigorously maintained.

# CHAPTER XIV.

## ON THE TREATMENT OF FALSE ANCHYLOSIS BY LACERATION.

False anchylosis.

By the term false or spurious anchylosis is understood that condition of a joint in which it has become fixed, or barely flexible in consequence of disease external to it. When the joint becomes involved, or rather when primarily affected, such changes occur to its organisation as clearly contra-indicate the resort to any violent measures to restore its movements. False anchylosis is the result of disease for the most part extrinsic to it. Its presence recognises a morbid condition either of the general areolar tissue about the joint; the fascial textures; the tendons of the surrounding muscles; or the ligaments. Whether these structures have been themselves the subjects of disease or otherwise, they participate in its effects. The absence of motion in the joint for a long period is sufficient to explain the stiffness which accompanies the first attempts to move it. But we have something more, we have deposits of fibrous matter gluing together all the tissues around the joint.

Causes.

One of the most common among the primary causes of spurious anchylosis is rheumatic inflammation, both in and about the articulation. The disease stops short of disorganisation within, but forms by deposition what is termed thickening around the affected joint. The attack may be renewed again and again—the joint becoming less and less capable of motion after each attack. At length it becomes so fixed and immoveable as to present the aspect of what is termed a stiff joint. So long as the disease exists, its movements, though painful, are not entirely destroyed; but when the active stage of the disease subsides, and gives place to reparatory and restorative actions, then the structures settle down as it were into the unyielding condition which marks the morbid character of the joint. When this stiffness is complete, the textures not only on the exterior are generally involved, but bands of fibrous tissue connect the opposed surfaces of the interior of the joint, wherever the absence of cartilage furnishes them with vantage ground for adhesion. In the knee we find them about the crucial ligaments, passing from between the condyles to the centre of the tibia; in the elbow descending to the groove in the articular surface of the ulna, also deprived of cartilage. Among other causes of spurious anchylosis may be enumerated violent sprains, dislocations and fracture of the bone or bones entering into the structure of a joint. In a greater or less degree, some amount of inflammation, probably both, of the synovial membrane, and also of the ligaments, follows. In this inflammation, the general tissues about the articulation participate, the temperature of the part is raised, and the joint is painful. If the bone is restored to its natural position, or, if fractured, is united to its parent shaft, although the integrity of the structure is re-established, yet stiffness follows, and especially so in cases which have been retained at rest for too long a period.

**Conditions necessary for success.**

In all these examples, two conditions are indispensable to the attempt to restore the joint to its natural function: the first is mobility, perceptible movement in however slight a degree; and, secondly, the total absence of pain or heat, or other manifestation of present disease. If there be no movement whatever, it is highly probable that disease has already committed ravages in the joint; and that partial or complete anchylosis of the bones is the result. Such anchylosis infers absorption of cartilage, and exposure of one surface of bone to the opposite. It is no part of the surgeon's duty, by breaking down this union, to interrupt the process of reparation, set on foot by nature for the purpose of restoration of the limb, but rather to encourage the perfecting of the process by rest, and by infusing vigour into the system. While on the other hand, if diseased actions be yet progressive, if the joint be hot or painful, or both; if the part will not bear rough handling, or if the person shrinks from such pressure as accompanies the process of legitimate enquiry, then may we infer a condition of the joint too near the date of active disease to warrant any appeal to operative proceeding. It is not sufficient that disease in its active and advancing shape shall have subsided; all diseased actions must have ceased for a period of months. If, instead of months, a period of years shall have elapsed; if the textures, consisting of muscle, artery, vein, nerve, and integument, have long settled down and assumed the attributes of a natural relation to the bones beneath; and we attempt to bend or to straighten a joint so fixed, we inflict an injury on the permanently contracted textures, equal to that of a normal structure similarly distorted by violence; and instead of restoring the altered condition of the part in the direction of a natural structure we are carrying it farther and farther from the standard of primitive formation. Such conditions of a limb are not amenable to any treatment with which I am acquainted.

This necessary absence of all diseased actions in the joint will become manifest when we consider the curative means resorted to, which consist in the restoration of the movements of the limb by the forcible laceration of the tissues which fix the joint. If this attempt be made before all diseased actions have subsided, reaction would inevitably follow, and pain, and swelling, and effusion, within and without the joint, would reappear with unerring certainty, only again to be succeeded by the increased immobility resulting from a yet firmer contraction.

**Method of operating.**

When the conditions above stated are obtained, much may be done towards the restoration of the movements of the limb, by the judicious application of force. Supposing the diagnosis of a joint fixed by spurious anchylosis to be correct, it is well to place the patient for some days under the restraint of a splint applied along the limb. Chloroform is, of course, a necessary ingredient in the treatment; and when fully applied, the limb, if held in the bent position, is forcibly extended by the surgeon bearing, if requisite, his entire weight on the affected joint. The heel in the case of the lower extremity should be supported on a wooden board, or may be extended at the same moment by an assistant. If fixed in extension, the leg should be brought to the edge of the bed, which may be employed as a fulcrum behind the knee, the part being protected by a pillow or other soft substance. Unless the adhesions be very strong or very chronic, which are almost synonymous terms, the force thus employed will be sufficient, and the textures will be felt to yield under the leverage thus employed for their extension. The sensation conveyed to the hand as well as to the ear of the operator is very peculiar, and not very agreeable; a sort of tearing, crunching sound, audible to bystanders, and raising ideas in the mind at the moment not in absolute accordance with the precepts of sound surgery. The only other example of a similar proceeding in the occupations of the surgeon, relates to the breaking down the newly-formed adhesions which connect a dislocated bone to the tissues around it. Here we have the same sensations conveyed to the ear, but not to the mind. In the case of dislocated bone, we have but to detach the head from an abnormal position, and we are thoroughly familiar with the nature of the individual fibrous texture to be rent asunder. In the example of the joint, we require a very correct diagnosis, and we involve in some liability to injury every structure of which the limb is composed, the bone alone excepted.

Various degrees of force requisite.

Various degrees of force are required in different cases, dependent on the nature and extent of the adhesions. In some cases, however firmly the joint is apparently fixed, the separation is obtained by a very moderate effort on the part of the surgeon, while in others, his entire strength may be required for the purpose; but under all circumstances, what is proposed to be done should be fully effected at the moment of extension, and every fibre detached that is detachable by such mechanism. The tendency to resume the direction of the old position is often very strong; nor is this surprising when we recollect the condition of the muscles which have been subjected to a sudden and violent elongation, consequent on the contraction probably of years. Resistance to this tendency by the immediate application of one or more splints is indispensable. The treatment of spurious anchylosis by laceration, is by no means an uncommon operation, and from the evidence of Mr. Brodhurst and others, is often attended with very remarkable success. Whether by the restoration of the functions of the joint in its original condition of health, or by the permanent elongation of a limb, now rendered subservient to many useful purposes in life—for one or other of these issues is always attainable in properly selected cases—the degree of benefit derivable from the effort will mainly depend on the original cause of the disease. In general or rheumatic affections of the knee, and especially if of long standing, the restoration of the joint can hardly be expected; while the limb itself may become a valuable agent of locomotion; whereas, in the anchylosis from fracture or former dislocation of the elbow or of lesser joints, all its movements may be entirely restored to health. I first broke down the adhesions of a knee-joint in St. Bartholomew's Hospital, ten years ago. A young woman was admitted with the express object of submitting to amputation of the knee. She had been the subject of repeated attacks of rheumatic inflammation, for which she had been under treatment in various hospitals, during a term of several years. Slight motion remained to the joint, which was permanently fixed in flexion at about an angle of 120°. The whole limb was enlarged, and the knee showed signs of previous discipline in a very palpable form. Under the influence of ether, I placed her heel on a board a little elevated above the bed, and leaning my weight on the joint, the detachment of the tissues both within and without the joint was audible around. I brought the limb into a line of direct extension, and fixed it to a back splint. Some tenderness rather than pain followed during the succeeding week, and then subsided. The limb again contracted notwithstanding my directions given to the House Surgeon, and in three months I was compelled to repeat the operation. The joint remained stiff, but the girl regained a serviceable limb for locomotion. I mention this case, not as an example of the best surgery, but because it was the first case of the kind that came under my notice.

The elbow-joint is perhaps most obnoxious to these contractions, consequent on its greater liability than many joints both to dislocation and fracture; and in no articulation is the treatment of spurious anchylosis more satisfactory.

Previous division of tendons.

In many cases of long duration, the muscles acting upon the joint, have become so contracted that previous division of their tendons is rendered necessary. There is no objection to this preliminary measure. In a doubtful case I should certainly recommend it. Indeed it often becomes advisable on other grounds. In the instance of the knee for example, even if we could succeed in straightening the joint without division of the hamstrings, the flexor muscles refusing to yield, will sometimes draw the tibia so forcibly backwards, that the effort to extend the leg must necessarily dislocate it.

If the division of any tendon is thought necessary, it may be done at the time. I see no reason why we wait for its partial repair before extending, as some advise. On the contrary, it appears to me a useless delay.

Mr. Brodhurst's recent papers on this interesting subject will well repay a careful perusal.

# CHAPTER XV.

## LATERAL CURVATURE OF THE SPINE.

NATURE OF THE DEFORMITY—CAUSE, REMOTE AND IMMEDIATE—PRINCIPLES OF TREATMENT—POPULAR ERRORS—AGENTS OF TREATMENT—OPERATION OF TENOTOMY.

Among other kinds of deformity, for the treatment of which the agency of operative surgery is occasionally employed, is that arising from lateral curvature of the spine. It is very true that these resources are not often very available to good, and that the operation for dividing the tendon of the erector spinæ is comparatively rarely resorted to, and has been still less commonly adopted in this country; but, when we consider the frequency of this distressing affection, and the general want of success attendant on its treatment, consequent on its somewhat exclusive, and not very scientific character, although lateral curvature may hardly enter into the catalogue of those diseases which engage the particular attention of the operating surgeon, yet I cannot persuade myself to pass the subject by, without the endeavour to enforce the importance of certain principles, the observance of which appears to me indispensable to the limited success that must ever attend them.

Knowledge of myology essential to treatment.

It cannot be denied that a disease, or rather a distortion of this kind, which involves the morbid action of the immense number and variety of the muscles of the trunk, greater than any other known disease, demands a more than general amount of anatomical knowledge for its treatment—a knowledge of the attachments and action of the muscles involved in the abnormal condition of the body; nor can it be denied that the class of practitioners, by whom the treatment of lateral curvature is greatly monopolised, do not in general possess that intimate knowledge of their actions, or of the means of developing their growth and their relative importance in the economy, which is so requisite for success. The treatment generally adopted in this country, as well as on the Continent, is, in my opinion, so perfectly erroneous in principle, that it is not surprising how little is gained by its adoption, and how universal is the feeling of dissatisfaction expressed by the parents and relatives of the affected persons.

Remote causes.

The cause of lateral curvature, if considered in its most remote relation to the effect, is the presence of some temporary imperfection of one, or of inequality of power between the two lower extremities, as the pillars of the trunk. So long as the weight of the body is transmitted to the ground by two pillars of equal strength, so long will the vertebral column occupy the central space between them; but reduce the value of either as a pillar of support, and, the weight remaining unchanged, the opposite limb performs the extra duty. But as the spine is rendered flexible for the purpose of facilitating the transmission of the weight of the body to the perpendicular line over each leg in progression, so the continued disposition to form a perpendicular over one extremity, rather than occupy the centre between the two, is effected at the expense of the opposite limb; and the spine, accustomed to assume this direction, gradually loses its symmetry, and becomes permanently drawn from the centre to that point over which its weight is most readily, and with the least effort, transmitted to the ground. The primary cause may present itself in the most apparently insignificant form. Any source of local pain, such as chilblain, a tight shoe, or a sprained ancle, is sufficient to effect all the injury that may ultimately follow in its train.

We are, however concerned with the effects, which unhappily advance by such insidious steps as to render distortion positive before it has created observation. The eye of the servant or attendant has become familiarised to the growing evil, and months may elapse before the suspicion of wrong is whispered in the family. The effects of curvature are manifested, not on the spine, but on the ribs, which being fixed at each extremity to the vertebral column and to the sternum, are pushed outwards at their angles behind. The first deviation from the vertical line of the spine occurs in the centre of the

Distortion referable to the ribs.

body, where nature has given the greatest degree of mobility to the column, viz., in the lumbar vertebræ. This first deviation requires a second, in order to bring back the head to the centre. It is this second deviation in the dorsal region of the column that causes the general distortion.

The projection backwards, though caused immediately by the distorted form the ribs, is further increased by the necessary relation of the scapula and shoulder placed upon them. On the opposite side the scapula lies with its anterior surface applied on the flat surface of the ribs. Whereas, on the affected side it lies on the projection formed by the eminence of the distorted ribs. It is thrown upwards, and the consequent elevation of that shoulder is inevitable. As the disease advances, the projection behind becomes greater, and in the same degree the ribs become flatter at the side of the chest, and this cavity gradually loses in front what it has gained from the projection behind. By the concavity of the curve directed towards the opposite, the ribs of that side approach unnaturally towards each other, the intercostal muscles become absorbed, and the ribs eventually overlap. From some cause or other, the dorsal curve, is, in young women, almost invariably to the right side, with its concavity to the left. In boys it is frequently reversed. The capacity of the chest is materially altered. The act of respiration is performed very disproportionately on the two sides. While that of the projecting ribs permits the full expansion of the lung, particularly in the antero-posterior axis of the chest, although that lung is flattened at the side, the opposite and generally the left side of the thorax, is materially abridged of its natural dimensions. The lung is reduced in size, and the heart is forced to the mesial line behind the sternum, or sometimes to the right side of that bone. In the aggregate, the capacity of the lungs is reduced in volume, and the general health betokens difficult and impaired respiration. Such patients will always adopt the side position in bed, lying on the weaker or contracted side of the body. If the two hands be applied on the side of the chest, in the act of inspiration of the patient, the difference of degree to which each lung enters into that function will be obvious. The influence of this condition on the muscular system of the

Elevated shoulder.

Absorption of intercostal muscles.

Respiration.

Disparity of opposite muscles.

body is equally worthy of remark. All the muscles of the upper extremity, on the side of the projection, are fully developed, while those on the opposite, are in the same degree reduced in volume and in power. If the two arms be extended to a right angle with the trunk, it will be observed that the one is held more firmly and longer than the other. If a dumb-bell be placed in each hand, the difference becomes still more apparent. The lower extremities give equal evidence of the inequality of their power. The large muscles of the spine, the especial office of which is to maintain its upright position, and which, consisting of the sacro-lumbales and longissimi dorsi, are called the levatores spinæ, from their action, undergo also considerable change from their natural form and bulk. The lowest part of these muscles, which corresponds with the lumbar vertebræ, are enlarged by excessive action on the convex side of the lumbar curve, and are in the same degree atrophied on the opposite. The same muscles in the dorsal region have their conditions reversed, that of the one side being enlarged, that on the other reduced and almost absorbed. The trapezius muscle, where it occupies the back of the neck, is swollen into a thick cord-like mass, and is equally small on the corresponding one. The same remark applies to the serratus magnus and latissimus dorsi muscles. Such are the effects produced by the first deviation from the natural form of the spine. Young persons in this condition are incapacitated for occupation, and for most of the enjoyments of life.

Erector spinæ.

Entire recovery almost impossible.

The first question that should be asked, is, Does such a case admit of cure? The answer is, *Certainly not;* and the first duty of the surgeon is, to impress this fact on the minds of the responsible persons concerned, or at least to admonish them against the indulgence in a hope that cannot be fulfilled. All the benefit that art can furnish, is improvement, and the degree of improvement depends, first, on the age of the person, whether in childhood, or girlhood, or of yet more advanced age; secondly, the firmness or flexibility of the frame; and, thirdly, on the moral aid afforded to the surgeon by the resolution and capacity for endurance exhibited by the patient. As a general rule, the latter quality is developed in proportion to the advanced age of the subject. When a girl reaches seventeen or eighteen years of age, and finds herself insulated from the society and deprived the amusements and occupations of her natural associates, the deprivation begets a vigour of resolution that will sustain any effort or suffering without complaint. For myself, I make it a rule of conduct to decline the charge of a case, without I possess the full confidence of my patient, and unless I observe a manifest disposition to enter on the treatment with earnestness and resolution.

Youth desirable.

General neglect of early treatment.

'With respect to age, the less advanced the better. Lateral curvature rarely exhibits itself under thirteen or fourteen years of age, and it is very seldom that parents have recourse to surgical aid for one or two years afterwards; or, indeed, to state the case more truthfully, it is rarely that any approach to efficient treatment is resorted to till the expiration of some two, three, or four years, when the advancing distortion attracts the notice of casual observers, and not till then are all the resources of surgical skill called in requisition. In the outset of the case, the mother exhibits the girl (for this malady prevails in females to the extent of nine out of ten cases) to the surgeon attending her family, who recommends friction and exercise. Occasionally the treatment involves rest in the horizontal position, and the application of a bandage, or some form of spinal support, with which the family remain contented. But some of the worst cases I have attended have been treated by friction alone, and occasional rest. If a girl be under fifteen or sixteen years of age, great benefit may be obtained by positive treatment, but the amount will lessen with the advance of every year beyond. With respect to the time required for such partial recovery as the case admits of, it *must be calculated by years*, not by months. It is impossible to effect any considerable improvement in the figure much distorted by curvature, within a period of two years, or to confirm the benefit then obtained, without the loss of a third. I do not hesitate to say, that the promise of an earlier result can never be realised, whatever treatment be adopted, because growth is indispensable to recovery. The restoration of the projecting ribs and the spinal curve can only be effected by the agency of time, and no art can accelerate the speed of natural growth.

The agents usually resorted to in lateral curvature, are, as I have mentioned, friction, bandages, and rest. The indications to be obtained, are those of straightening a curved spine, forcing back the projecting ribs, and restoring equality of action to the muscular system of the two halves of the body, by developing the power of those muscles whose action has been long held in abeyance. Among the latter, the intercostals stand prominent, both in importance in the healthy economy, and in difficulty of access.

**Rest and gymnastic exercise worthless.**

Against these requisitions, let me point to the agency of friction, bandages, and rest! A supposed advance in the treatment, which carries patients onward in the path of delusion, consists in the resort to gymnastic exercises, in climbing, hanging the weight of the body by the arms, using dumb-bells, &c. What is the efficacy of gymnastic effort in reference to curvature of the spine and distortion of the ribs, the real gravamen of the disease? Can exercise elongate the spine? can suspension of the weight of the body by the latissimus dorsi and pectoralis major, press into place the firm projecting ribs, or expand the chest in its transverse diameter? If not, little has been accomplished. Exercise may, by developing the muscular system, mask, but it cannot even tend to cure the deformity, and the mask holds good only so long as the exercise is continued, and no longer. There can be no objection to, but, on the contrary the greatest benefit arising from exercise; but it is ill-timed; it should *follow* not *precede* other treatment, and to rely on exercise alone is, to abandon the case to permanent deformity.

With a view to select the most efficient treatment, we must keep in view the requisite indications. We are required to straighten the spine, to regain the natural form of the ribs; that is to say, we have to reduce the prominent feature of the deformity, viz., the projecting ribs on the one side, and to enlarge the capacity of the chest on the other, by effecting an equal change in their abnormal curve, and, finally, to strengthen the muscular system.

**First treatment to remove the weight.**

The first consideration in the treatment consists in removing the cause of the entire evil, viz., the superincumbent weight. The patient must be confined to the horizontal position. The evil is not so great as it appears. The horizontal position is quite compatible with health, with education, and with the enjoyment of life. A narrow bedstead should be selected for the purpose, of about three feet in breadth, and moving on large wooden castors, by means of which it may be wheeled about in any direction, altering its relation to the room, both by day and night. The patient should lie on a well-made wool mattrass. There is no objection to one of Earle's beds, which might be so constructed as to move on wheels in a garden, or at least out of doors. With respect to health, I have had abundant opportunity of observing, that if not improved, at least it is not impaired. I have never seen an example of injury to the health from the required confinement. Education, so far as relates to the acquisition of knowledge, may be advanced, and is advanced more positively, than by others who pursue the more general routine of occupation. As regards accomplishments, neither music, except in theory, drawing, nor dancing, are admissible. Any form of needle-work is unobjectionable.

**Rest compatible with health and education.**

How is the spine to be now elongated? It will not grow straight from the impress of four years' curvature. It must, therefore, be drawn out, by the application of weights, which will operate by the reverse action to that of pressure downwards, under the influence of which the disease has grown to maturity. Extension should be made from the two extremities of the spinal column; that above, by a belt applied around the chin and occiput, attached to a cord passing over a pulley, let into the head board of the bed, and supporting a weight of from ten to twenty pounds. That below is attached by a broad belt around the pelvis, and including the crista of each ilium. To the sides of this belt are two straps, that unite below, and to them may be attached a weight of from twenty to thirty pounds. This extension may be worn sixteen hours out of the twenty-four of each day and night. I can conceive of no more efficient mode of elongating a curved spine than this; yet it is far from a powerful agent. It is employed, however, simply because we possess no other.

**Extension.**

How is the attempt to be made to restore the projecting ribs to their natural form and relations? Can we materially influence the form of a bone by increasing the power of its muscles? Can we straighten a twisted

**Restoration to form of the ribs.**

bone, or curve a straight one? There is but one mode with which I am acquainted, and that is by pressure; firm, hard, and continuous pressure. For this purpose, a large pad, covered with soft leather, arched to fit the projecting curve, should be employed, and fixed by means of a screw, passing through an upright, fastened to the bedstead. This pressure will prove agreeable, rather than otherwise, by the support it affords. This first and most important seat of pressure, requires, of course, counter-pressure on the opposite side of the body. There are two situations in which pressure may be made without pain or much inconvenience; viz., on the hip and on the base of the neck immediately above the clavicle, both of which must be fitted with screws and pads corresponding with the opposite, but of smaller size. The first pad should be so made as to press, not in the transverse or horizontal direction, but in that obliquely forwards; the two latter may press horizontally. This lateral pressure should be maintained as firmly as the patient can bear, for much of the success of the treatment depends on its efficiency and permanence.

Enlarging the capacity of the chest.

A third part of the treatment consists in enlarging the capacity of the diminished half of the throax. We have no instruments for this purpose—no agents by which the ribs can be drawn outwards. Difficult enough is the task of forcing-in the projecting ribs, but far greater is that of urging those that are depressed in the contrary direction. Having no artificial means at our command, we must draw on the resources of Nature, and compel her aid. The diaphragm and intercostal muscles are the primary and only important agents by which air is carried into the lungs in respiration. These powers are exercised contemporaneously during health; but in the cases under consideration, nearly the entire of the action is sustained by the diaphragm alone, consequent on the reduced and weakened condition of the intercostals. If we can arrest, or at least control, the action of the diaphragm, the intercostals must be roused to action, and we endeavour to effect this object by compression of the abdomen. The application of a thick and soft pad of lint or cotton wool, or a pad containing bran or horsehair, should be made, by means of a bandage passing across the abdomen; and it may be drawn sufficiently tight to produce a somewhat laboured respiration. By this means we control the action of the diaphragm, and throw the duty of inspiration on the intercostal muscles, which will gradually respond to the influence of this compulsory action, and acquire force; and at the same time the compressed cavity of the chest will gradually expand. But this, though a work of months, will repay the effort, and, by perseverance, the chest will be moulded into a greater or less approach to its natural form, according to the tolerance of the patient, and the activity of the surgeon.

This principle of treatment should be persisted in till observation of the back, to be occasionally made, obtain conclusive evidence of positive improvement. Nor, indeed, should it even then be desisted from, but rather modified as we approach, at the expiration of from eighteen months to two years, or possibly more, the period for entering on the second stage of the treatment.

**Second stage of treatment.**

This treatment consists in bringing into action the muscles which were reduced in power at the commencement of the restraint. The condition alluded to involves the muscles of the back, and the large muscles connecting the arm with the trunk. Of the former we must bring into action the *levator spinæ*, and of the latter, the *trapezius, serratus, latissimus dorsi, rhomboidei, levator scapulæ*, and the *deltoid* and *biceps*.

**Action of levator spinæ.**

For the purpose of exciting to action the first of these, the levator spinæ, the patient should be placed on her face, and desired to raise the head and trunk off the bed, and to support them in this attitude for a few seconds. This exercise should be repeated many times in each day. In the course of a few days, a ring of shot, of the weight of about four or six pounds, should be fitted on to the back of the head, for the purpose of increasing the effort of raising the head from the horizontal line, and should be applied continually during the exercise. At the expiration of a month, more or less, the same exercise should be performed on an inclined plane, with the head placed below the level of the body, in order to increase the range of action, and the effort may be made of slightly increasing duration each day. By such means the two levators spinæ muscles will increase in strength and magnitude, and will tend to give a more equal support to the spine than it has been long accustomed to from them.

Serratus and rhomboidei.

A certain amount of exercise of the serratus and rhomboidei is quite compatible with rest in the horizontal position, and may be effected by means of a pulley screwed into the ceiling of the room, through which should pass a line, attached to a weight of as many pounds as can be raised by an effort; this weight may fall into a padded basket, to prevent noise. The rhomboid and serratus muscles are brought into action by retracting the arm, when carried forward to its fullest stretch; but the arm should not be bent for this purpose, or we employ another series of muscles, the biceps, &c. The duration of this effort, like the last, should be determined by the power of endurance. The longer and the more frequently it is continued the better; and in this example, as in the last, the weight should be increased with reviving power in the muscles.

Muscles of lower extremity.

By such exercises all the muscles may be strengthened in their action, and none should be neglected. But it must be fully understood, that this important stage in the treatment should follow rest and pressure, and that it can have little, if any, influence on the form of the chest. The muscles of the lower extremity may also be brought into action in the horizontal position; but generally this is not necessary, for on resuming the upright position, and on throwing aside restraint, it is surprising how comparatively little power of locomotion is lost. Any and every kind of exercise may now be adopted.

Artificial weight.

The treatment I have above recommended, refers, as I have said, to cases of curvature of the spine, in which distortion has advanced considerably. In less advanced cases, in which the defect of form is hardly perceptible through the dress, simpler measures may answer the purpose of preventing increase. Even in such examples, the removal of the superincumbent weight for a large portion of each day is most desirable, by the patient's lying down: great care should be bestowed on position, and the weaker leg brought into more active occupation. A very useful agent of treatment, which I very frequently employ, consists in a weight applied on the head, in the form of a ring or coronet, containing shot, varying in weight from four to eight or ten pounds. The weight may be sewn in a tube of strong linen or ticking, and tied under the chin. So long as the weight is worn on the head, the facility of transmitting it to the ground without effort, almost compels an upright position of the trunk, and it may be worn, whether during exercise or while sitting, for many hours during the day. It is this habit of carrying weights on the head that renders people accustomed to this practice so particularly upright, which is rendered so manifest in market-women and soldiers. In fact, it is the only position of ease, for the moment the body is inclined from the perpendicular, the muscles are brought into action in order to support it. If the patient, divested of her clothes down to the loins, be placed in the sitting position on a stool, with the weight applied on the head, and desired to carry the head laterally and circularly in all directions, the influence of these movements on the spinal muscles will be readily observed, and this, indeed, forms as good an exercise as I can suggest, particularly if the patient be required to bend the head somewhat forwards.

But, however active these exercises, it should be clearly understood, that they can have no influence on the ribs if protruded, or replace the elevated shoulder if dependent on this cause. Here we treat what may be strictly called curvature of the spine. In the more advanced cases we treat *curvature of the ribs.*

**Operation of tenotomy.**

The question of tenotomy is occasionally raised in the treatment of curvature of the spine, and there is no doubt that the operation may be resorted to with benefit in suitable cases. If the lumbar curve be very marked, indicated by a tight cord passing upwards, parallel to the lumbar vetebræ from the pelvis towards the angle of the last ribs, it may be divided with advantage. But in dividing the tendinous covering of this part of the levator spinæ, no advantage can arise from dividing the muscle also. If the knife be introduced on the outer side of the muscle, and passed inwards to the spine, with its flat surface applied on the muscle, and its edge then turned downwards, the tendinous surface of the muscle may be divided, and nothing more. It will be immediately observed that the spine may be brought out into a straight line in this region. Still it is an operation, the benefit of which has been largely overrated, although I think I have often seen it useful, when applied to well selected cases.

As regards the ultimate treatment of curvature in cases in which much yet remains to be done in the form of restoration, benefit may be derived from a support raised from a belt of strong leather encircling the pelvis, the pressure of which is regulated by a screw, and when fitted to the person is scarcely observed through the clothes. Its influence is not, however, entirely passive; for by its continued pressure it retains the spine in a position most favourable to ultimate improvement.

# CHAPTER XVI.

## TALIPES, OR CLUB-FOOT, AND SOME DEFORMITIES OF THE FEET AND HANDS.

The treatment of this form of distortion constitutes one of the greatest triumphs of modern surgery. By its agency it may be reasonably asserted that already thousands of young persons have been qualified for active occupation in life, who would formerly have been consigned to perpetual lameness, and to the compulsory selection of pursuits of a more or less sedentary kind. In restoring such persons to activity, the surgeon restores them in no less positive a degree to health, and to some of the greatest enjoyments of life. The history and gradual progress of this interesting branch of surgical science is foreign to this work, and, therefore, I proceed to the consideration of the disease, its nature, causes, and treatment.

**Nature of the disease.**

Club-foot, or *talipes*, is the result of a morbid condition of one or more of the muscles moving the foot, whether in flexion, extension, abduction, or adduction. It owes its existence to any cause which may interfere with the sufficient supply of nervous influence, or arrest of the current of nutrition to the muscles. This may be produced by a local, or constitutional, or a general cause. An attack of fever in a young person may be followed by loss of power of one or more muscles. The spine may be injured; or the spinal centre of the nervous system, as in the process of dentition, may be the seat of what we term irritation; long confinement, repeated attacks of muscular rheumatism, local violence to muscles, each and all are sufficient to produce it. Any of these causes may occur in early life, and many in early childhood, to explain the loss of contractile power in any given muscle, or in any number of them; and the loss of utility of one muscle infers that of its antagonist also, for these muscles

**Causes.**

of the extremities will not long retain their healthy action without antagonism.

Talipes is also a congenital disease; that is to say, that children, by virtue of their position in utero, exhibit at the moment of birth a contracted relation of the foot to the leg, varying in degree in different subjects. In children of ordinary force of circulation or of nervous power, this slight distortion is rectified by every day's growth, and the foot gradually assumes the attitude required for supporting the weight of the body, while in others, wanting these powers, the distortion increases as the child advances in age; and when once the muscles succeed in drawing the foot to the side of the tibia, instead of directly against it, those of the side opposite to that to which it is drawn, acting to a disadvantage, lose their power of antagonism, and the disease becomes permanent. The evidence of imperfect nutrition, which now exists in the relation of an effect as well as a cause, is obtained from the wasted condition of the muscles, and from the low temperature of the limb.

Effects of disease.

The proximate cause of talipes refers itself, not only to the muscles which, being reduced by inaction, have become rigid and contracted, and in which the contractile fibre is greatly diminished in proportion to the tendinous material which enters largely into the composition of all muscles, but also to the ligaments and to the bones themselves, both of which gradually bend under the influence of the unnatural conformation of parts. The ligaments are distorted, the plantar fascia contracted, and the bones reduced in size and thickness, the limb is shortened as the disease advances, and the tibia is attenuated in structure, in obedience to a universal law, which requires active employment of structure, as the sole condition of development and health.

Talipes varus.

Talipes is divided into three forms. The most common is that in which the foot is drawn inwards, by the action of the tibialis anticus and posticus, and it is called *talipes varus.* This form is usually congenital, and owes its existence to the position of the child in utero, as has been stated by Mr. Tamplin. The second is *talipes equinus,* in which the foot is extended, the heel being raised by the gastrocnemeus and soleus muscles. The third form is *talipes valgus,* in which the foot is turned outwards by

Equinus.

Valgus.

the contraction of the peronei attached to the outer side of the foot.

Distortion of the foot, especially in those examples of the talipes varus which are congenital, may be rectified by the application of pressure applied in the opposite direction to that in which the foot has a tendency to turn, also cases of talipes occurring in children after fever or other forms of illness. Such examples may be treated by daily extension, by friction, and by tonic medicine. During the last ten years, treatment by steady and persevering extension has greatly prevailed over the former almost invariable resort to the knife; and cases hitherto deemed incurable, except by division of one or more tendons, have permanently yielded under this simpler treatment of well regulated extension, to the power of which it is almost impossible to place a limit. Still the necessity for division is obvious in many cases, were it only undertaken with reference to the question of time; and to the working man the rate of speed of his recovery is too important an element of treatment to be disregarded by the surgeon. Any tendon may be divided that presents an obstacle to the natural position of the foot, and for this useful operation we are indebted to Dr. Stromeyer and to M. Delpech.

**Union of tendons.**

When the division of a tendon is made by the knife, a new material, that may be termed callus, is formed in the interstices of the section, which unites the opposite ends. This material is susceptible of elongation, to an extent commensurate with the loss of length sustained by the muscle, and probably more, if required. By this division of the tendon of any given muscle, we destroy the tension on its antagonist, and give it the opportunity to exert its power of contraction, and of recovering from its state of long inaction; or, at least, we can influence the less organised structures, by placing the foot mechanically in the position most calculated to support the weight of the body.

**Four stages of treatment.**

First. In order to effect the object without injury, the tendon or tendons to be divided should be exposed as little as possible. The operation is a subcutaneous one. Mr. Paget has confirmed our knowledge of the fact, that exposure of the tendon is often followed by inflammation and suppuration of the wound. Moreover, the tendon itself may separate by exfoliation. The division should, therefore, be made without violence or displacement of the parts divided. Secondly. Immediately after division, the parts should be healed by the first intention, by being brought into contact with each other, and maintained at least during the entire period required for their union. Thirdly. Inasmuch as the elongation of the tendon can only be obtained by that of the new fibrous material intervening between the divided ends, so the extension of the tendon should be gradually and carefully made to the length requisite for recovery from the distortion, before the new material has become firm. Fourthly. When this degree of extension has been effected, the foot should be fixed in the position, and so retained until the new substance has acquired the requisite degree of consolidation.

Dr. Little has remarked, that the left foot, in cases of double talipes, is generally more thoroughly affected than the right; but this must be accidental. Of the three forms of the disease, that of varus is the most common, this being the form incidental to the period of birth, and that of valgus is the least so, this form occurring, though less frequently, at the same period.

Mode of detecting the erring muscles.

In order to ascertain the immediate cause of the deformity, the foot should be forced into its natural position, or into some approach to it. By this process the tendons causing the obstacle will stand out prominently, or may be felt in a state of great tension under the skin. In talipes varus, the tendons of the anterior and posterior tibial muscles are the palpable seat of the difficulty; in pure talipes equinus, the tendo Achillis; in talipes valgus, the peroneus longus, brevis, and tertius. It is needless to describe the course and relation of these muscles to the ancle-joint, because, if they exist as the passive cause of distortion, their tendons will stand out prominently enough to point to their own course. If description be required to indicate their position to the surgeon, the cause must be looked for, and the remedy also, elsewhere.

The knife employed for division of these tendons is necessarily small, and should be delicately made. The blade should be nearly straight, with the edge slightly turned up at the point, towards the back, and the cutting edge should not extend beyond eight to ten lines in length; and, inasmuch as the blade is useless beyond the cutting edge, so it should stop at that point, and be connected to the handle by a round stalk of half an inch in length. These proportions will give length sufficient to deal with any tendon requiring division about the foot of a child. If the blade be too acute at the point, it will pass through the tendon without giving evidence of its course to the hand, should the knife be directed against, instead of underneath it, and by having the blade short the skin will be cut only in the act of introducing it.

After the division of the tendon, the foot is bound up in a common roller, until two or three days after the wound is healed. At the expiration of four or five days, the foot is placed in Scarpa's shoe, made of thin flexible tin, by which the extension of the divided tendons is rendered permanent.

Operation.

The operation is very simple. The foot being well examined, we ascertain, by placing it in its natural position, the locality of the contracting agent. The foot is then held by an assistant in such a position as to render this cause as prominent as possible. The knife is then introduced underneath the tendon, with its flat surface towards it; and in withdrawing the knife the tendon is cut slowly asunder. If we have hit the cause aright, the tension on the foot will be immediately relaxed, and the sensation caused by this relaxation is sufficient evidence of the completion of the division. In withdrawing the knife, its back should be pressed against the wound, and a depression between the divided ends of the tendon will confirm our almost certainty of the division.

Posterior tibial artery.

In talipes varus we divide the tibialis posticus. It is better to introduce the knife about two fingers' breadth above the malleolus, in order to avoid the posterior tibial artery, which I have seen divided, and give rise to troublesome hæmorrhage. In confirmed or advanced cases of this form of talipes, other tendons will require division, such as those of the tibialis anticus, gastrocnemeus, and sometimes the plantar fascia; but it is not necessary, nor even desirable, that all be divided at one time.

Compound cases.

Cases sometimes present themselves of a compound nature, formed by a combination of either of two kinds, such as the equino-varus, or equino-valgus. It is needless, in such or in any cases, to lay down a rule as to the tendons to be divided. Any tendon may be divided, or, indeed all, consecutively, provided the foot continue deformed after the division of one or more. The earlier the treatment be undertaken the better. I believe Mr. Tamplin, of the Orthopedic Institution, has performed the operation of tenotomy on a child of five weeks' old; but I am inclined to think this age objectionable, unless required from some specific cause. I prefer to select from three to four months, and before the period of dentition.

After-management.

Cases of talipes require a great deal of care and trouble in the after-treatment, of which the operation constitutes but a small fraction. The child should be visited every day, unless placed under the observant eye of an intelligent attendant. A period of from six to twelve or eighteen months is requisite for the cure of extreme cases of talipes, equinus and valgus, while for early cases of varus, from three to four months will generally suffice.

## ON CASES OF PARALYSIS OF THE ELEVATORS OF THE FOOT.

In the cases of old paralysis of the elevators of the foot, which we so frequently meet with in advancing boy- or manhood, much benefit may be obtained by judicious treatment. These cases are allied to talipes equinus. Here the foot is distorted, but in a slight degree, though its growth and that of the leg have been interrupted by want of action. The muscular agents of the body, and especially of the extremities, are so balanced as to obtain perfect rest only by their conjoint presence. Muscles, in themselves antagonistic, always wait on each other's actions. There would appear a mutual consent in this, for the purpose of controlling the movements of the limb in all its variety. So long as the flexor muscle continues inactive, the extensor is in a state of repose. But on the occurrence of the slightest degree of contraction in the flexor, this repose is disturbed by the exercise of the controlling or regulating power of the opposite muscle, which may be supposed to watch with a vigilant eye, lest a

Antagonist powers.

march be stolen upon it. In the cases I allude to, which may be taken as the type of many others, the tibialis anticus is the erring muscle, the failure of which may often be dated back to the early period of teething. The defective action of this muscle gives a peculiar gait in progression, which must be well known to all medical men, but who may not be so familiar with the nature of the disease itself. In the ordinary movement of the leg forwards in progression, the foot is raised by the tibialis anticus and peroneus tertius, as it is called. Without their aid the toes fall in the act of stepping, and are dragged along the ground, unless by an effort at partial abduction of the leg, the limb is thrown outwards with a kind of jerk into the segment of a circle; and this is just the movement which we recognise in persons who have lost the power of these muscles. The consequence of this loss is, that the muscles of the tendo Achillis, having no antagonism, gradually raise the heel, and fix the foot in permanent extension. The weight of the body is thus received on the ball of the great toe, the calf diminishes, and the whole leg dwindles.

**Action of tibialis anticus in progression.**

This condition of the limb admits of great improvement by art. The difficulty lies in placing the foot flat on the ground, consequent on the tension of the tendo Achillis. The first step to be taken is to bring the heel down by dividing the tendon. This division may be made anywhere within two inches of the os calcis; but it is more contracted in breadth at the distance of about one inch above its insertion into the bone, and this is the place that should be selected for the purpose. The tendon being divided, the foot regains its mobility on the tibia at the ancle-joint. A bandage may be applied, and the union of the tendon, elongated by its new material, completed in the manner above described. The second consideration relates to the requisite means of bringing the foot up, by supplying the loss of the tibialis anticus muscle. This is effected by a band of vulcanised India rubber, which is attached to the front of a firm and well-made boot, and carried up the leg to a strap applied around the upper part of the calf. Here the elastic substitute for the muscle is fixed. In the act of walking, the point of the foot is efficiently raised by the band, when drawn to the required degree of tension, and the

**Division of tendo Achillis.**

**Artificial elevation of the foot.**

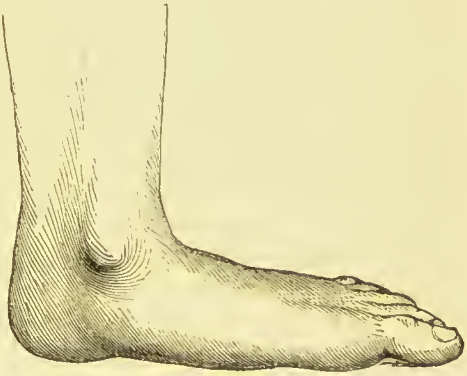
Compound cases.

gait of the child is entirely altered. The band may be completely concealed from view by passing within a boot. The circular movement of the leg and the accompanying jerk, which are instictively adopted for the purpose of raising the foot to the requisite height, are now no longer observed. In examining his person while walking, the head will be carried erect, and the movements be effected without writhing or contortion. The body continues upright, and the gait is easy and natural. In some cases the success is complete, and especially when the disease is confined to one leg; but the benefit is not so easily conferred when both limbs are affected. This treatment is especially applicable in cases of paralysis confined to the anterior tibial of one side only. In all complications the difficulty is increased. Unless a child feel confidence in the support to be obtained from, and possess entire command over the muscles of one limb, on which the weight of the body may be thrown, it is difficult to regulate the actions of the diseased limb with precision. Before proceeding to act, it is necessary that the condition of all the muscles be ascertained. In one case, having divided the tendo Achillis and fixed the above simple apparatus, I observed that the child always leant forwards, and rested its hand on the outer part of the thigh of the affected side. A fuller inquiry proved to me that the rectus femoris was involved in the loss of power, and the success was limited. In another case, of a very interesting girl, the loss of power in the front of one tibia was opposed by that of the posterior muscles of extension of the other leg. Here, also, some benefit was obtained, but the insecurity of the two limbs was too great to render the improvement perfect. When the disease is limited to one set of muscles only, much good may be done by the application of the above principle. In the case of paralysis of the muscles which move the leg forwards in progression, the addition of a well-adjusted elastic strap, extending upwards over the knee, and attached to a belt applied around the abdomen, will supply the place of these muscles of the thigh when paralysed, and both increase and regulate the movements of the person in progression.

## LOSS OF THE ARCHED FORM OF THE FOOT.

Among other forms of distortion to which the foot is liable, is that in which its arched structure is lost, and the entire foot falls flatly on the ground. The consequence of this disposition of the bones is perceived in the entire gait of the person in the act of progression, and in which the foot falls like a dead weight on the ground at every step. There are few regions in the human body more beautifully contrived for the duties which are consigned to it than the foot. In the act of stepping, the foot is advanced forwards till the heel touches the ground. The weight of the body is then thrown upon the centre, and, finally, at the moment of raising the foot, on the toes, while in a state of extension. This alternation of surface corresponds with the form of the segment of a circle, on which the body may be said to revolve in the act of progression. So long as the arch of the foot is retained, its presence gives elasticity to the gait. This arch may be compared to a bow, the cord of which is represented by the plantar fascia, the bow itself by the arch of bones. This fascia being rendered tense by the weight of the body, allows just sufficient play between the bones to take off the effect of the shock to the body when the foot is placed upon the ground. If the cord be relaxed the foot falls, and the arch is lost. Such is the condition of persons the natural structure of whose feet has undergone change, whether at the hands of nature or of art.

**Elasticity due to the arch.**



The arched form of the foot is due not only to the plantar fascia, but most especially to the position of the astragalus, which is supported by the calcaneo-scaphoid ligament, extending forwards to the navicular bone. If this ligament be elongated, the head of the astragalus, which forms the summit of the arch, descends towards the ground, and hence flattening of the foot, by destruction of the arch. This form of the foot is occasionally observed in all classes, but more especially in the lower, where it is the result of a natural conformation, but in young persons it owes its existence to the interference of art. Among the greatest offenders against nature may be classed the teachers of the art and mystery of dancing, whose course of instruction teaches the necessity of directing the toes outwards at an angle of at least one hundred and twenty, and the only reason why this angle is not carried up to that of one hundred and eighty, which completes the straight line, is the impossibility of effecting it, without dislocation. This folly yet prevails. Natural form, which is identical with natural beauty, ease, and elegance of gait, each and all are sacrificed to a morbid taste as ridiculous as it is fatal to nature's own design. Nature designed the foot to be so far only everted from its fellow, that the toes might be kept free from collision in the act of walking, but the dancing-master, more learned in his vocation, requires this angle to be largely increased, and the consequence is, that we observe in all students of this noble art, a distortion of the foot proportioned to their observance of its rules. In all persons devoted to the study and practice of dancing as an occupation, the foot is more or less flattened and the astragalus projects more or less inwards. The remedy consists, first, in avoiding the cause, and, secondly, in habitually retaining the foot in a straight position on the tibia. When the foot in this straight position appears, as it often does, somewhat everted, a piece of thin cork should be introduced into the boot, or what is better, the sole should be made about a quarter of an inch thicker on the inner than on the outer side of the foot; and these measures will prevail, in the course of a few months, in reinstating the foot in nature's own position. Before resorting to the remedial agency of position, we should clearly understand that the deformity is a disease and not a malformation. I was consulted about a little girl, whose feet were considerably deformed in the above manner. Finding no benefit to arise from treatment, I made an application to the mother to see the father's shoes, and this led to the

Cause of deformity.

Eversion of foot.

Treatment.

Cases.

desire to see the feet also, and in them lay the root of the evil. Treatment was useless. I saw the daughter of a gentleman, who had just returned from a *finishing* school. The same deformity had made some progress in both feet. Without making any other inquiry, I said, "I congratulate you in having obtained the prize at school for dancing." She looked up in surprise, and inquired how I had obtained the knowledge of the fact. The main fact I knew from the form of the foot. The secondary fact I guessed at, and guessed rightly. The absence of the cause, viz., the resort to the natural and unrestrained position of the feet, succeeded in six months in the entire removal of the evil.

Cause unexplained.

There are some curious facts, yet unexplained in pathology, connected with this subject. A young man of twenty years of age applied at St. Bartholomew's Hospital, who had become quite lame from the gradual falling of the astragalus of both feet. The disease had appeared within six weeks or two months of his attendance: he could give no account of the cause, and the pain of which he complained appeared rather an effect than an attendant symptom, on the change of structure. This alteration in the organisation of the foot appears to resemble in its nature that of the knee-joint, which, without apparent cause, is forced inwards, rendering the subject of the disease what is called knock-knee'd. One articulation or both may be affected. I have known it make its appearance in early manhood without any explicable cause, and increase until a limb has been rendered almost useless for the purpose of progression. One is naturally inclined to attribute the change of structure to relaxation of the internal lateral ligament; but such relaxation would by no means explain the mystery. I have heard it referred to absorption of the external semilunar cartilage; but the thickness of that structure is quite insufficient to explain the great degree of obliquity, nor can I understand the nature of the deformity in question, except by inferring disease of the bones themselves, of which I could obtain no local evidence. There is no local pain or swelling, no sensitive surface to fix the observation of the surgeon. The entire joint appears involved in the new attitude. Neither relaxation, thickening or absorption of either ligament, cartilage or fibrous tissue can explain the nature of the change. Bone is the only remaining structure.

## CASES OF CONTRACTED FINGERS.

This disease is often of serious inconvenience to the subject of it. Chronic inflammation attacks the fibrous tissue of the theca, and extends to the skin and palmar fascia, the effect of which on the finger is to produce a permanent contraction, with hardness along the line of the tendon, and more than one finger may be involved in the contraction; but the disease mostly commences in the little and extends to the ring finger, and both hands may be similarly affected. The division of the fibrous structure is followed by reunion of the parts, and no benefit is obtained by the experiment. The attempt at recovery of the finger should be set about very systematically, or success will not attend it, and the entire hand may be crippled for life. The hard skin and the fascia underneath it must be dissected out, and if the tendons be involved, they should be divided; but probably the division of one will be sufficient; the finger may then be straightened, and fixed upon a splint, until the healing process is completed, and for some time afterwards. It is very desirable not to denude the exposed tendons of their cellular investment, or they will be liable to adhere to the skin in the process of cicatrisation.

**Difficult to cure.**

*Web-fingers.*—The fingers are occasionally connected to each other by integument passing between them, and preventing their use singly. If the web be simply divided, the disease returns almost inevitably, whatever care be taken to prevent it. Mr. Liston suggested an excellent mode of curing this disease. He introduced a ring into the web at the root of the fingers, and allowed the opening to cicatrise in the manner of the ear-ring, and he then divided the web, and rolled the fingers separately. I have adopted this treatment in several cases with complete success. I am not certain that the completion of the cicatrising process is indispensable to a cure. In the case of a young woman in St. Bartholomew's Hospital, in whom the cicatrising process was remarkably slow, I divided the web before the process was completed, and her recovery was perfect. In the case of a gentleman whose hand had been seriously injured by ignited phosphorus, I divided three very extended adhesions uniting the fingers nearly up to the first phalanges. In lieu of any preparatory treatment, I treated him by means of the application of a metallic instrument by which I could maintain permanent extension. His recovery was rapid and at the same time complete.

# CHAPTER XVII.

## OPERATIONS FOR NECROSIS, CARIES, ABSCESS IN BONE, ETC.

Necrosis.

THE frequency of these operations is mainly due to the introduction of chloroform. Under its influence we explore cavities, or sinuses, and thus acquire a sufficient knowledge of the condition of bone or other deep structures to justify the removal of such as being beyond the reach of recovery are the fruitful source of many evils—local pain, loss of locomotive power, and impaired health. Local abscesses, consequent on fever, deficient nutrition, impure or corrupted atmosphere, are their too frequent antecedents to lead us to doubt their relation as a cause. The progress of such abscesses is slow and unhealthy, and when formed in the neighbourhood of bone, that structure may become more or less involved, and the death of the periosteum and subsequently of the bone follows. This result is not due to any especial tendency to disease of the bone, but simply to the want of sufficient vital force to bring an unhealthy chronic abscess to maturity. The cavity of the abscess may be filled up, but one or more sinuses remain, at the bottom of which we detect dead bone. The destruction may involve the outer surface only, or may even extend to the medullary cavity within. The more ordinary cause of necrosis is of course the well understood one—previous inflammation of the shaft of the bone. If the disease has existed for a period of many months, or a year or two, it is highly probable that a dead portion of the shaft of the bone has separated from the remainder and lies loose in the medullary cavity. To this dead fragment the name of "sequestrum" has been given. So long as dead bone exists at the bottom of a sinus, whether on the outer surface or in the form of an internal exfoliation, the wound will remain open, and it becomes the duty of the surgeon to remove it by operation. Occasionally the diseased action may extend to the medullary membrane only, and one or more sinuses remain patent for years. On such a case I operated in the month of May last: A boy of eleven years of age, the son of poor parents, left London for the purpose of obtaining work in the country. In this endeavour he failed, and after tramping the country round for many weeks, almost without food—at least supported by a very inadequate quantity—he became ill and had fever. A large chronic abscess formed in his thigh. Four or five sinuses followed, for which he was admitted into St. Bartholomew's Hospital. These openings presented on the outer surface of the limb, and bone was detected at the bottom of each, the probe passing clearly into its medullary cavity. The disease had existed during eighteen months. My own impression was, that the shaft of the bone was largely involved, and in consequence I made a free incision through the vastus externus, along the outer side of the limb. On exposing the cavity the medullary membrane was inflamed, thickened, and in many parts reduced to a pulpy condition; but there remained no dead bone. I removed the membrane, and the boy recovered.

On another occasion I exposed the cavity of the ulna near the olecranon, and detected nothing beyond diseased medullary membrane; but, in both these cases, the operations were successful to the entire restoration of the functions of the bone.

Caries.

Caries of bone, more especially of the tarsus, if not amenable to milder and more patient treatment, will often justify operative interference. In these cases, we seek to remove all dead, diseased, and even suspicious bone, scooping it out, guided in our operation by the direction and extent of the mischief. We continue to excavate so long as the exposed bone appears dry—until we bring into view bleeding bone—for this is a convenient and tolerably safe test of its vitality.

Some of these operations on the tarsus are attended with the happiest results. I have on several occasions removed a great portion of the entire tarsus with apparently very little impairment to the subsequent functions of the foot.

Abscess in bone.

We are also compelled to explore the cavity of bone under circumstances of suspected abscess. These cases are remarkable, and, to the surgeon, highly interesting. They may occur spontaneously, or in consequence of a blow, or other injury affecting a bone lying near the surface, such as the tibia, and especially in the neighbourhood of the malleolus. They are attended by severe pain, referred to the interior of the bone, and occurring either constantly or at intervals of greater or less length; the longer the intervals the more chronic the disease. The bone becomes thickened, and the integuments over it are more or less tender on pressure. The pain often occurs in paroxysms, dependent on some condition of the system, or following prolonged exercise.

It is clear that the disease is not of a malignant nature, its progress is too slow—if progress may be said to be made at all. Months, and even years may elapse, and the disease remain in the same state of obscurity.

Under these circumstances, which are slightly only mitigated by the application of leeches, cold sedatives, or blisters, the bone should be exposed by operation.

The following case illustrates the pertinacious character of abscess in bone: Mr. K. had an attack of pain in the lower part of the tibia, which subsided after rest and the application of cold evaporating lotions. At the expiration of some months the pain returned, and was again relieved by similar means. These attacks of local pain recurred at longer or shorter intervals year after year, the pain being very great and accompanied by heat and tension of the skin in the neighbourhood. In the course of four or five years the tibia became thickened, and the branches of the saphena major vein were partially imbedded within it. Towards the close of a period of some twenty-five years these attacks became more and more serious. They were protracted to a period of many weeks, during which Mr. K. scarcely ate, slept, or moved from his couch. His health suffered severely, and his occupations in life were brought to a close. He was himself anxious to have his limb amputated, and having obtained the concurrence of three surgeons of eminence, the operation was all but determined on. Calling by accident at this date on my friend, he told me what had occurred, and to prove himself in earnest, opened a box by his bed-side and took out to my astonishment a wooden-leg. Being throughout

Case.

impressed with the belief that his disease was that of abscess in the bone, I stated the case on the following day to Sir Benjamin Brodie, who visited Mr. K., and expressed an opinion concurrent with my own. Three days afterwards the tibia was trephined. After cutting down through solid bone to the depth of about half an inch, from one to two drams of healthy pus escaped, and all pain ceased. At the expiration of about eighteen months Mr. K. finds himself in possession of a very useful substitute for his wooden-leg.

Operation.

In order to expose the cavity of a bone, a free incision should be made along the line of the external sinuses, supposing the bone to lie nearer to the surface on the affected side; but supposing the orifices to present on the inner side of the femur or humerus, the exposure of the bone should still take place on the outer side, on account of the less important textures to be divided. The bone may be laid bare to the extent of from two to four inches,—but determined by the distances of the openings through the skin,—and the orifice or orifices of the sinuses into it be fully exposed. Various are the implements in use for breaking down the wall of the bone — saws, forceps, gouges, chisels in all variety; of these, perhaps the most efficient is the gouge or curved chisel, which should be employed, if necessary, with the aid of a wooden mallet, by which instruments, assisted by the valuable parrot-bill forceps, the exposure of the cavity will be quickly effected by moderately dexterous hands. The cavity should be fully exposed, and when opened a white surface of dead bone will commonly present itself, which, when grasped by the dressing forceps, will be found moveable in its socket. The "parrot-bill" forceps is an admirable instrument when employed for the purpose of detaching small angular projections of hard bone, which it separates with great rapidity. If the jagged sequestrum be of much greater length than the opening made, and extend in each direction beyond it, the dead bone should be broken by the aid of cutting forceps, and each half extracted separately, but with due care lest it be broken in the act of removal. The finger may be introduced into the medullary cavity, in order to verify the supposition that all dead bone is removed. However jagged may be the sides of the opening into the bone, they should remain untouched. The cavity may then be filled with charpie or cotton-wool, and the edges of the wound brought somewhat close. Mr. Gay insists with much force and reason upon the complete closure of the wound, so far as it can be accomplished after an operation. The lint may remain in the bone for two or even three days in cool weather, and the wound subsequently dressed daily. Nature will eventually fill up the cavity, and finally close the outer wound.

When there is good reason to suspect the disease to be abscess of the bone, a small trephine should be employed in place of the gouge or the saw. Its advantages are obvious, as limiting the violence done to the bone to the seat of disease within it. The bone should be exposed to a size corresponding with the aperture to be made in it, and its fibrous periosteum fully divided. The instrument is applied over the point indicated by the previous pain. The bone will give unequivocal signs of disease by its increased thickness, both at the commencement of the operation and in its progress. The medullary cavity will be probably reached with greater difficulty than will be anticipated, supposing the matter to be confined within it, and the depth considerable, owing to the increased thickness of the walls of the bone. If the matter be confined in the substance of the wall, the cavity of the abscess may be more readily exposed, and it will be detected by the moisture oozing from the groove of the trephine. The central portion of bone should, however, be removed, and the integuments, if practicable, be brought into apposition.

I admitted into St. Bartholomew's Hospital, in October last, a man of thirty years of age, who had suffered severe pain at intervals in the region of his left thigh-bone at its lower third for fourteen years. A sinus had formed on the inner side of the limb, but had closed. A second sinus had formed on the outer side, which communicated with the femur, but I could not detect an opening into the interior of the bone. The femur was considerably enlarged, to the extent of about six inches above the condyles. The history of the disease pointed to it as spontaneous.

With this evidence I exposed about four inches in the length of the femur by an arched incision, the flap of which was curved downwards. By mallet, chisel, and gouge, I opened the cavity of the bone, and removed a dead portion of bone about two inches in length. The man recovered, having lost all the local symptoms of disease for which the operation was undertaken, and he walks without either pain or lameness.

Within the last few years I have operated successfully on a large number of cases of necrosis of the femur, tibia, os calcis, humerus, and bones of the fore-arm. I have at the present time no less than seven cases in St. Bartholomew's Hospital in progress towards recovery.

# CHAPTER XVIII.

## ON TUMOURS.

LOCAL AND CONSTITUTIONAL — BENIGN AND MALIGNANT — CASES FOR OPERATION — CASES FOR REJECTION — VARIETIES OF TUMOUR — —TUMOURS OF THE BREAST.

Definition.

Local or constitutional.

THE employment of the knife is more frequently called into requisition by the surgeon in the treatment of tumours, than in any other disease. By a tumour we understand a morbid growth, assuming more or less a definite form, and distinct from what we more appropriately term a mere swelling or enlargement of a part. Such growths, for the most part, occupy the external surfaces of the body. The motives for their removal are founded either on the inconvenience of their presence, their obstruction to the movements, or other functions of the body, or on their tendency to disorganise parts, and involve in their growth any texture around them. In some forms of tumour the morbid action is purely a local one, involving no structure but that immediately around it, while in other cases the disease appears as the product of a constitutional liability, in the production of which, although it occupies a region only, the constitution takes early cognisance of, and adopts as its own. This distinction of a *local* and *constitutional* tumour is more generally, though often incorrectly, recognised under the terms *benign* and *malignant.*

Often doubtful.

Another ground of distinction is founded on the greater or less liability to involve in their growth the textures around, whether muscle, tendon, or bone itself. Such a disease is often deemed malignant in its nature, although the constitution may be apparently free from its ravages, and so long as the circulation deposits the material for morbid growth in any remote part of the body only, it is difficult to say how far this growth is dependent on a local action or on a general one. And yet, if the growth be removed from one part it will develop itself in another. The pathology of tumours is an exceedingly difficult subject, and notwithstanding various efforts made by eminent members of our profession to subject them to some definite classification, the success has been hitherto very equivocal. If we take the subject of cancer, how uncertain is its diagnosis, and how different the opinions expressed of its probable return, on removal! The variety in these views is founded on that of the disease itself. Cancer is seen as a torpid, sluggish, and painless growth, occupying the mammary gland for years, and often forgotten by its possessor, or has long ceased to create alarm—a hard knot, involving no texture, apparently insulated from the circulation, and closely resembling, in its character and in its history, a purely local disease. It is also seen in the same situation pursuing an active and vigorous career of mischief, extending over the breast, contaminating by its touch the entire body of the gland, cellular tissue, and skin, and destroying life in the course of a few months. In the first of these cases we often operate in the early stages with advantage; in the second, death is the result; but in neither case do we find evidence, on examination, of the existence of the same disease in the cavities or internal structures of the body.

**Uncertain diagnosis of cancer.**

We generally attach to the idea of a malignant disease, a growth that, however simple in its nature or composition, has the power, as it increases, of involving other structures around it, and blending them into itself, having a tendency to return, when to all appearance entirely removed by operation, either in the situation of the former wound, or in the textures of the viscera.

**Involving other textures around.**

But the above definition of a malignant growth will not universally apply, for no disease is more oppressive in its actions on the neighbouring structures than an aneurism, which, as it enlarges, absorbs the contiguous bone to any extent, with the muscles attached to it. Neither will the third part of the definition universally hold, because, in some rare examples, cancer itself has not returned, even during a protracted life.

One mode of lessening the difficulty of the attempt to class tumours, and to distinguish the malignant from the non-malignant, is to take the more chronic forms of

**Cancer not always malignant in its action.**

cancer out of the category of malignancy, and looking to the indisputable fact, that cancer may remain dormant and harmless for ten years in the female breast, and that the same disease may not be reproduced on removal, and also that cancerous tubercles of large size may be found in the liver, and in other organs, of persons who have died from other and dissimilar diseases, we may infer that there is a condition of cancerous disease which does not answer to the definition usually given of malignant tumours. Of course I speak only of cancer in its scirrhous and thoroughly chronic form.

Difficult diagnosis.

It would appear, that however palpable the line that distinguishes the positive characters of benign and malignant, or local and constitutional tumours, yet, that as each approaches the confines at which the two diseases meet, the difficulty of discriminating the one from the other, in forming an opinion on any given case before the tumour is exposed, is almost insuperable. And in this respect the surgeon has greater difficulties to contend with, than the pathologist. It is one thing to diagnose a disease by manipulation, and another by dissection. When called on for an opinion as to the expediency of an operation in any given case of tumour, we judge by manipulation, by our knowledge of the anotomical relations of the tumour; we learn its history, its rate of progress, its physical characters of form, density, &c. The tumour being removed, is then subjected to the closer inquiry of the pathologist, and the microscope may be required to facilitate our decision.

Microscope.

But it is obvious that this decision has reference to the past, and not to the future. The microscope with its enormous power of penetrating morbid structure which carries our visual powers into the arcana of nature, and may be almost said to expound the primary idea of formation by the Creator of animal life affords no support to the judgment of the surgeon, while to the pathologist it is but an erring guide. Doubtless there are signs and manifestations of disease presented to the eye under microscopic power which are often valuable and which tell a tale of malignancy unrevealed to the naked eye. But it cannot be denied that knowledge thus acquired is too often delusive in its nature to warrant an absolute reliance on evidence obtained by such form of inquiry.

A correct diagnosis not always essential.

However great the difficulty of forming a correct judgment as to the liability of any given tumour to return after its removal, or rather of deciding whether the rudiments of the tumour are entirely eradicated from the body, yet the necessity for a correct judgment on that subject is by no means invariably required to justify its removal by operation. Almost all tumours have a tendency to increase in size. We infer that, if not requisite at the time, their increasing growth will, ere long, demand their excision, and therefore we operate at once, because every day increases the evil, and most especially in the early stages of those tumours which are of a malignant, or even of an equivocal nature. As a general rule, we endeavour to remove all tumours that we can reach, and yet the exceptions are sufficiently numerous to require the observation, and to demand the obedience of all prudent members of our profession.

Cases for rejection.

1. We reject the operation in all cases of suspected malignancy, in which the diseased growth extends within the cavities of the body, including in this rule of conduct cases in which the absorbent system, whether of the groin, axilla, or neck, is positively involved in the same disease.

2. We reject the operation in tumours of large size, the anatomical relations of which probably involve important structures or large arteries not accessible to the operator.

3. We reject the operation in large and suspected tumours, existing in a weak constitution, in which the hæmorrhage would probably prove fatal, or even very injurious.

4. We reject the operation in quiescent tumours in old age, that will probably survive the life of the person.

5. We hesitate in the performance of an operation for the removal of a tumour, that having been once removed, has re-appeared in the same, and still more if in another locality, in the direction of the trunk.

Axillary glands involved.

In disease of the mammary gland, supposed to be of the schirrous nature, the glands of the axilla are, as is well known, frequently affected. The question arises, what is the real condition of these glands? Is the enlargement malignant or benign in its nature? If malignant, and more especially so, if many glands are involved, the fact should preclude the operation; if benign, there is no benefit derived from their removal. My own observation leads me to believe, that consequent on schirrous disease of the mammary gland, and especially of a chronic character, the axillary glands become enlarged by simple irritation, and continue enlarged for a length of time, before they undergo the change which identifies them with the original disease; and, consequently, that the presence of one or more enlarged absorbent glands in the groin or axilla, does not necessarily preclude the question of operation. If they are numerous and hard in texture, the question of operation should be at once met by a negative. I do not think, therefore, that we gain much by prolonging the operation for excision of mammary tumours, by dissecting into the axilla, and removing often a portion only of the diseased glands. How uncommon it is to see disease returning in the axilla! If the glands are inoffensive in character, it is needless to remove them; if malignant, it is useless. This rule may admit of exceptions, but is on the whole a salutary one.

Simple enlargement in early stages.

Excision of glands generally useless.

It must be acknowledged, under the most favourable circumstances of glandular enlargement, that their existence is not desirable. Their presence always indicates a disposition in the constitution to identify, or at least, to interest, itself in the actions of the morbid growth.

With regard to the question of malignancy, there is no doubt that this character prevails in various degrees. All tumours known as malignant are not equally destructive. If we take hard cancer and the forms of soft cancer, known as medullary, encephaloid, and fungoid varieties, the malignant actions vary greatly in degree from each other; the extirpation of one by the knife, would be justifiable, when, in the case of the other, none but a rash operator would undertake it.

Variable degrees of malignancy.

We are justified in removing all tumours, with the above-given exceptions. Tumours require removal on various grounds. Some are unsightly, and involve exposed regions of the face or neck; some, are inconvenient to the person, or obstruct the free movements of the body. Some are painful, whether in themselves or occasioning pain by pressure on surrounding parts. Some obstruct functions by their mechanical influence, or are likely to do so in the progress of their growth. Of all such tumours it is our duty to advise the removal.

We operate generally on the principle of prevention. We remove a tumour in its early stages, to obviate its injurious effect on the person in the later; and we operate at an advantage, because we contend against a lesser, instead of a greater evil. Nor can I altogether agree with Dr. Walshe in his estimate of the value of previous treatment. Sooner or later, the operation must be submitted to. The treatment, *quoad* absorption, is nugatory; and it appears to me that the less we molest them by local agency the better. General treatment, that has for its object the improvement of health, such as fresh air, when impregnated with iodine, tonic medicine, &c., is, of course, admissible at all times.

Encysted tumours.

The most common form of growth is the encysted tumour, which presents itself in the form of a rounded and well-defined mass, generally moveable in the tissue around it. This moveable character of tumours is indicative of the simple and inoffensive nature of the growth. They are, for the most part, painless, unless molested by pressure, or other form of violence. Encysted tumours are prone to appear about the head and neck, and sometimes accumulate on the scalp in numbers. But in any region of the body, a rounded and well-defined growth, usually not exceeding the size of a pigeon's egg, which often rolls under the pressure of the finger, and has existed for many months, and probably years, is more or less elastic to the hand on pressure, gradually increasing in size, and free from pain, is probably an encysted tumour. The difficulty of the diagnosis increases with its depth. The peculiarity of the disease consists in the secretion of the substance of the tumour, whatever that may be, whether what is called steatoma, atheroma, or melliceris, by a firm and thick cyst or sac, to which the diseased actions are confined. When such tumours, situated about the neck, reach an inordinate size, they are termed wens. They have been treated by puncture, but they are liable to inflame, and to become a source of positive danger.

Wens.

Removal of

The removal of the entire cyst is an object of some entire cyst not necessary.

importance, and yet not of the importance generally attached to it, for, provided the greater portion be removed, the remainder is powerless for evil, its morbid action being destroyed by the operation, provided the wound does not heal by the first intention. However, it is very desirable, and far easier on the whole, to take the cyst away entire. The depth of the cyst below the level of the skin will best determine the form of the external incision. If protruding from the surface, or lying upon it, two incisions, passing round the base and elliptical in form, meeting exactly at their angles, will leave a straight line for union. The line of incision should be calculated with some care. If deeply seated, a single incision, of greater length than the diameter of the tumour, will answer the same purpose. When encysted tumours are so situated with respect to other structures as to render dissection around them difficult or dangerous to the structures, also when a cyst is adherent, and not very accessible, the quickest operation is effected by making an incision straight down through the entire body of the tumour to its base, evacuating the contents, and drawing out each half of the cyst entire. If the cyst, being very thin, burst in the process of removal, and the contents are evacuated in the necessary force required to detach it, supposing a small portion of the cyst to remain behind, if the part be scraped by the knife, little fear need be entertained of the disease being reproduced. I have never seen nor heard of a case of an encysted tumour having returned, however clumsily removed, and should the wound not heal by the first intention, its return would appear still less probable. In cases in which, being often hereditary, many of these tumours occupy the scalp, and may achieve the magnitude of a small orange, some danger attaches to the operation for removing them, unless great caution be observed. Not more than one of the largest, or one or two of the smallest should be taken away at any one time.

When an encysted tumour is removed from the face or neck, great care should be taken in the management of the external wound.

Adipose tumours.

One of the most common forms of growth is the fatty

Structure.

Enlarged veins.

tumour. It is, generally speaking, indigenous to fatty regions, and is found about the shoulder and scapula, back of the neck, and nates. It may be known, with some approach to certainty, by its tuberculated and elastic feel, caused by the projecting lobules of which it is composed, its ill-defined margin, its slow progress, its painless character. Except when it presents itself on or about the shoulder or groin, it almost invariably occupies the trunk of the body. When small in size, and situated in the region of much subcutaneous fat, it is composed of small masses or lobules, each of which is more or less encysted by a layer, or sacculus of condensed cellular tissue, and the margin apparently blends with the surrounding fat. When it has reached a large size, as in protracted cases of long standing, the lobules become large in proportion, and their cellular investments strong, and almost fibrous. When the integument is closely adherent to the tumour over a considerable surface, the tuberculated character stamps the nature of the disease at once. In large examples of the fatty tumour, situated in the track of cutaneous veins, as the cephalic or saphena, the pressure of the tumour on the venous system, produces the growth of an abundance of large cutaneous venous trunks, which ramify over the tumour, and give it, in the judgment of some, a malignant character, simply because in some malignant growths a similar appearance, arising from the same cause, often presents itself. These veins, occupying the skin covering fatty tumours, are very harmless, and may be cut in any direction with impunity, provided the tumour which has caused them be removed.

Cases.

I removed an enormous tumour of this kind from the groin of a woman, in which the veins were larger and more numerous than I have ever seen them before or since. This woman lived in a country village, and was an object of curiosity to medical virtuosi throughout her neighbourhood for miles around. The loss of blood did not exceed six ounces. I removed a fatty tumour of about the size of an orange, from below the axilla of a somewhat stout married lady, of about thirty-five years of age, who had borne no children. Her breasts owed their roundness and symmetry rather to the presence of fat than to glandular structure, the place of which, fat vicariously and commonly supplies, I suspect, as life advances. The peculiarity of this case consisted in the absence of the lobulated structure usually found. It appeared to consist of simple hypertrophy of the ordinary fat of this region, and had no definite boundary in any part of its circumference.

To be drawn out by the hand.

An incision should be made in the axis of the tumour and down to it. If it be closely adherent to the skin, some difficulty will be found in detaching it with the knife; but the diseased growth must be insulated, and by far the best agent for this purpose is the hand. The accomplishment of this object by dissection is slow, uncertain, and bloody; that by the hand is rapid, sure, and bloodless. As soon as the tumour is sufficiently separated from the surrounding parts, the fingers may be insinuated around and underneath it, and some force employed to detach it from the normal structure around, the knife being retained for the division of the fibrous tissue only. This may be done with force, but not with violence. It is more sure, because the diseased, will more entirely and cleanly separate from the healthy structure around, by tearing than by dissection, for in the latter case the eye is deceptive, and the knife impetuous and arbitrary in its movements; and lastly, the vessels being torn asunder, will be less likely to pour out blood than when cut across by the knife. Great care and time should be bestowed on the endeavour to arrest all hæmorrhage before the edges of the wound are brought together. The space of the former cavity should be obliterated by considerable pressure from without.

Enlarged cervical glands.

Tumours occur in the neck of various kinds, a few of which only justify the interference of operative surgery. The great majority of these diseases consist of enlarged absorbent glands. It is true that we may have encysted tumours in this region, but they are not of common occurrence; we have also aneurisms, but they are still more rare, and we have various forms of enlargement of the thyroid body. The latter disease is occasionally obscure, especially when one lateral lobe only is affected. It is occasionally attended with some effort of deglutition. The isthmus of the thyroid body lying upon the trachea, sometimes presents the form of a rounded tumour of the size of a marble, while the rest of the organ retains its normal character; more than once I have had such a case brought to me for removal. The nature of the tumour may be known by its occupying the locality of the thyroid body, and its connection to the trachea may be inferred from its rising and falling in the act of deglutition. Enlarged absorbent glands of the neck, so common in children, rarely, if ever, justify the resort to the knife. We occasionally have one or two become more prominent than the rest, and appear almost insulated; and if a real difficulty to the functions of respiration or deglutition be traceable to their presence, we are justified in removing them; but it must always be recollected, that this evil forms but one link in a chain, and so far as my experience goes, such operations, though affording temporary relief, are followed by a rapid increase of the diseased actions.

Rarely the subject of operation.

The name of *epithelial cancer* has been given, of late years, to a modification of cancerous disease, and which is deemed to be semi-malignant in character. This is generally the nature of cancers of the lip, of the external organs of generation, and also of cancer scroti. It owes its name to the identity of its microscopic appearance with that of epithelium, the cells being very similar. There is often, however, more or less of true cancer mixed up with the epithelial disease. In removing such tumours with the knife, there is less necessity to cut wide of the disease, or to take away much of the adjacent skin, than in cases of positive malignancy, this disease being less reproductive, and when we consider the structures attacked by it, this practical fact is important, and may be valuable, especially as regards the structure of the lip and the genital organs.

Epithelial cancer.

It is surprising how large a portion of the lip may be removed with very trifling subsequent deformity, if a moderate amount of ingenuity be bestowed upon the operation, and the wound carefully treated.

Cancer of the lip.

Cancer of the lip is almost always seen upon the lower one, and appears in either of two forms, the distinction of which is of practical importance. It is superficial—spreading widely, or circumscribed—penetrating deeply. In the worse cases, it is often both wide and deep, but generally the distinction may be drawn. When superficial, the diseased portion may be quickly cut off by a horizontal section, whereas in the deeper form a V shaped incision is preferable, the edges being subsequently brought into absolute contact, and treated after the manner of hare lip.

In the more extensive cases, when the disease has spread irregularly into the surrounding parts, the number and direction of the incisions should be a matter of careful study beforehand.

The first consideration is the complete removal of the disease, every incision should pass through healthy tissues, the second is to make such a wound as will subsequently produce the least possible amount of deformity.

When the extent and shape of the wound will not permit its edges to be brought into apposition, of course it must remain open and heal by granulation.

Cancer scroti.

*Cancer scroti* is an affection of the skin and subcutaneous cellular tissue, caused by the irritation of soot, which becomes ingrained in the rugæ of the scrotum. From the scrotum it extends forwards on to the integument of the penis, and backwards to the perineum. Its progress is very slow, and the disease very chronic. However extensive, it rarely attacks the testes or the body of the penis, although in an advanced stage, either structure may become adherent to the diseased growth, but this adhesion is an exception, and not the rule. In extreme cases affecting the skin of the entire organs, the fissure of the thigh, and even the inguinal regions, although it was formerly the practice to remove the testicle and even the penis, I do not recollect to have ever seen these structures involved in the disease. In more than one case the scrotum was entirely removed, and the testicles bared of the whole of their natural investment, but a new and tight scrotum formed over them. The fibrous tissue of the penis, as also the tunica albuginea of the testicle, appears almost insusceptible to the action of the disease.

Organs rarely involved.

The verucous-looking growth should be dissected carefully from off the testicles, and, in like manner, detached from the fibrous structure of the penis. Some additional care will be required in removing the diseased structure from the corpus spongiosum. If the perineum be involved, the patient should be placed in an attitude similar to that for lithotomy. In this locality the diseased actions extend somewhat more deeply, but the bulk of the spongy body forms the guide, and below this object the presence of no vessels or other structures exist to preclude the entire removal of the disease.

Malignant tumours.

The more malignant form of disease, known under the terms, *fungoid*, *medullary*, *encephaloid*, and *melanotic cancer*, more generally attack the lower extremity than any other region. The head of the fibula is its frequent seat. The nature of the disease may be suspected by the diffused character of the swelling, which cannot be made to suppurate or to yield to ordinary remedies. As the swelling enlarges, the skin becomes tight and shining, the absorbent system of the limb is affected, and the leg swells below the tumour. By slow degrees of continued and uninterrupted increase, the swelling becomes enormous, involving all the textures of the limb in its growth, more especially the bone and the muscular system. The tumour conveys to the fingers, on pressure, a sense of elasticity, which is greater in some parts than in others, and *also of obscure fluctuation*, as though its contents were fluid. This last symptom has deluded many, I may say most, and the tumour has been punctured again and again, under the idea of evacuating fluid, but little more than a few drops of bloody serum escape.

Sometimes these malignant growths are tolerably well defined, and, occasionally, so firm throughout as to give the impression of a fibrous tumour, so uncertain is our knowledge at the present day on the subject of tumours; for definition of the margin of a morbid growth is a bad criterion to rely on invariably, although, as a general rule, we may often derive a valuable hint from its presence, or otherwise.

The only remedy, and that of very uncertain efficacy, is amputation far beyond the disease. To detach such a tumour by dissection is impossible, all parts being equally affected. It would be inexpedient to bare the bone or the muscles; and supposing the artery, vein, and nerves to pass through its substance, it is not possible that the cellular investment of these structures will be free from contamination. Before entering on the operation, not only in the case of this form of disease, but also in that of many doubtful forms of tumour, it is always expedient to introduce a fine trocar or a grooved needle deeply into the morbid mass, in one or even two situations. Should simple puncture fail to throw light on the nature of the growth, we should proceed to make a deep incision into it. It may prove to be an abscess or a cyst, or to contain fluid blood, not that this latter result would necessarily rescue the patient from the alternative of amputation.

Puncture before operating.

With respect to all tumours of a doubtful nature, surgeons cannot be too cautious in their diagnosis; the best judgments fail, and the highest authorities are the least prone to express an opinion of their nature.

Escharotic treatment.

During the last year or two, some hope of a better control over malignant disease, and more especially of hard cancer, has been entertained by the reputed efficiency of the escharotic treatment. The agent hitherto generally employed is chloride of zinc. It is much to be regretted that the confidence claimed on behalf of this treatment is not justified by fuller and more general inquiry.

## TUMOURS OF THE BREAST.

There is no region of the human body to which the resources of operative surgery are so frequently applied, as that now under consideration. Perhaps there is none in which the opinions of medical authorities more widely differ as to the expediency or inexpediency of the resort to the knife; and it is much to be regretted that the subject of treatment of these most frequent of all serious diseases to which the female sex is liable, should not be brought under the deliberate observation of a general board of inquiry, with a view to institute more definite rules of conduct than at present govern the treatment by the profession at large. Until the subject is investigated by the united judgment and observation of the leading members of our profession, each man will be guided by the defective light of his own limited experience; and it is no unreasonable inference that many and larger operations are resorted to, than are demanded by the occasional necessities of the disease.

Tumours requiring removal.

The female breast is the seat of many and various diseases, both malignant and non-malignant. It is no part of the proposed scheme of this work to discuss questions which strictly relate to diagnosis, and I shall restrict myself to the enumeration of such forms of morbid growth, occurring in the breast, as have hitherto proved themselves incurable by any known treatment, local or general, and to which the agency of operative surgery is demanded, as one indispensable alternative to recovery. These are—1. Chronic mammary tumours. 2. Sero-cystic growths. 3. Every variety of malignant disease, known under the general title of cancer. 4. To the above may be added any morbid growth situated either in or upon the mammary gland, not being classed under any of the above titles, that exhibits an active disposition to increase, unchecked by treatment.

Caution needful.

The occasional—I may say, the frequent—obscurity which attaches to mammary disease, demands the rules of conduct relating to exploration, to be rigidly enforced. All obscure diseases should be tested not merely with the needle, but with the knife. An incision into a tumour, obscure in its nature, however large, is a far lesser evil than that of the entire removal of the disease which subsequent observation may prove to have been curable without it.

Indications for operating.

By far the larger number of affections of the breast demanding the aid of operative surgery, consists of diseases situated in the substance, but not of the gland itself. Indeed I know but of one disease affecting the entire organ, on which the question of excision can be raised, viz., cancerous infiltration. All other forms consist of disease generated either within or upon it. I shall most readily place before the reader the conditions on which the operation for extirpating disease of the mammary gland may be undertaken, by enumerating those which the experience of eminent surgeons had determined as presenting objections precluding the resort to it, and the presence of which, individually or collectively, will in all probability, on such terms, lead to a fatal issue.

These rules of professional conduct are intended to apply most especially to operations for malignant disease, because in none but malignant disease is the question which relates to the probable return of the morbid texture applicable. With regard to benign growths of all kinds, involving the region of the breast, their extirpation is justified on the grounds, either of local pain, of increasing magnitude by which the mammary substance is absorbed, or distortion of outline. In considering the conditions, contra-indicatory of the operation in malignant growths in the breast, we attach weight, 1st, to the age of the person, and 2nd, to the rapidity of the growth. We reject operations in aged persons, because experience assures us of the probability of the reproduction of the diseased growth at a period beyond which her life may not actually be prolonged; and it cannot be asserted, with any show of reason, that the operation will tend to prolong it beyond its natural term. Still less is it advisable to proceed to extirpation in persons of advanced life, supposing the disease to increase with more than usual rapidity, because experience teaches us that the term of reproduction after the operation is proportionate to the rate of growth before it.

The operation is objectionable in advancing life, inadmissable in old age, unpromising when age and rapidity of growth are combined together. It should be declined in persons beyond midage, when the disease is large, and the required exposure of surface still larger. It should be declined in cases in which the growth, itself large, has reached the ulcerative stage; and especially so, if the ulcerated surface be extensive. Still more urgent are the objections in cases of considerable enlargement of the axillary glands, combined with swelling of the corresponding arm, of tubercular deposits in the skin around or about the breast, some of which may occasionally be seen occupying the skin below the clavicle, and even extending above it.

The directly opposite conditions to the above, can alone warrant the advice of the surgeon, that his patient should submit to the operation. Fair average health; a tumour of moderate size—the less, the better; moveable on the breast and not fixed; unbroken healthy skin around it; inadherent to the skin; the absence of enlarged axillary glands. These conditions, in the aggregate, justify the employment of the knife; but in cases of cancer or other forms of malignant disease, they give no warrant to the surgeon for withholding from the patient the convictions of his own mind as to its probable return, within a term of one, two, or three years. Whether this communication be made directly to the patient, or indirectly through her friends, will depend on the mental character of the subject of the operation.

Operation.

In all diseases of the breast of a non-malignant nature, all that is required to be done is to remove the morbid growth. The size of the external incisions should be commensurate with that of the disease, and if occurring in early womanhood, for obvious reasons, the nipple should be left untouched. A single incision in the case of a small tumour will often suffice to complete the separation, although, as a general rule, two are of course required. If the disease prove to be benign, it should be dissected out from the mammary substance around, to which it will be found to be connected with more or less density of tissue. I removed an enormous mass of disease by a single incision, from the breast of a lady aged forty, during last year. I was enabled to enucleate the whole mass, leaving the breast with its nipple almost entire. The disease was a remarkably fine example of the sero-cystic tumour, so ably described by Sir B. Brodie.

In the case of cancerous disease opinions differ in respect to the necessity of extirpating the mammary substance around. Many surgeons of experience consider that whenever the mammary-gland is the seat of cancerous growths, however small, it is indispensable to the best future prospect of the patient that the entire gland be removed with the diseased growth, while other surgeons are content with the free removal of the circumjacent portion of the gland only. I am inclined to adopt the latter course, and especially when the breast itself is unusually large. When of small size, and in a person of advancing years, the excision of the entire gland may be deemed an element of safety. Possibly it is so. Still it cannot be denied that as a general rule the first manifestation of returning disease appears in the integument, and to the skin and subsequent tissues it is often limited for a considerable length of time.

Hæmorrhage.

The excision of a large breast often entails the loss of a considerable quantity of blood. Loss of blood, when large, is the precursor and the cause of local inflammation, often incorrectly termed erysipelas. It entails constitutional fever, and severe illness, and protracted recovery. Every care should be taken to prevent hæmorrhage by pressure on the trunk of the vessels, and by securing them as quickly as possible. To one assistant should be consigned the charge of the subclavian artery, which should be firmly compressed against the first rib from the moment at which hæmorrhage appears from the thoracic arteries. The repressive influence of this pressure on the bleeding, varies from mechanical causes in different persons. In some persons it is eminently successful. The external incisions may be made in any direction, either vertical, oblique, or transverse. It is desirable, however to avoid an incision carried far upwards towards the clavicle, if possible. The lines of incision being previously determined, may be boldly and rapidly made down to the pectoral muscle; the diseased growth insulated by rapid dissection, and removed. If the bleeding be considerable, consequent on the pressure on the subclavian artery being inefficiently made, a thick mass of wet lint may be laid on the wound and pressed by the hand for a period of a minute or two, and the arteries then carefully tied to their smallest size, and the edges of the wound brought towards each other by good adhesive plaster.

After treatment.

The local management of the wound has no peculiarity to distinguish it from other wounds of equal magnitude. For constitutional treatment, I refer the reader to the chapter on the "After treatment of wounds," in the full conviction that the successful issue of the case depends on the strict observance of the important principle therein advocated.

We have the various forms of hard and soft cancer. *Carcinoma*, though more frequently occurring in later life may appear at any age, but is generally more formidable when, presenting itself between thirty and forty years of age, it assumes the character of soft cancer. These most malignant forms of the disease, rarely attack the female breast, which is the subject more especially of the hard scirrhous growth throughout the substance of the gland, involving the skin, or otherwise.

Hard carcinoma.

The hard carcinomatous tumour of the breast more frequently occurs above forty-five or fifty; is of slow growth, in proportion as it is chronic in its nature; is generally free from considerable pain, at all events from the lancinating pain assigned to it; is well defined; hard in texture; may be embedded in the substance of the breast, or lie on its surface; has a tendency to involve the skin by simple adhesion, and when placed near the nipple, draws it inwards. It attacks women who have, and who have not borne children. The axillary glands are most liable to become affected in this form of disease.

Diffused carcinoma.

The diffused carcinoma is a much more serious disease than the above. The general texture of a part, sometimes of the whole, of the breast is involved. The swelling is diffused—the breast swells, attended by shooting, irregular pains throughout its substance. It may occur at an earlier period of life than ordinary cancer, and appear even during lactation. As the disease advances, the skin becomes involved, participating in the activity of the action within, by exhibiting blushes of discoloration, which appear in patches on the surface. In some cases, these patches coalesce, and the entire skin of the breast becomes involved. In this condition the whole organ assumes a firm and incompressible mass, as though cut out in marble, and throughout the entire stages of advance the nipple may remain prominent. I attended such a case, which was seen by Sir Benjamin Brodie, Mr. Travers, and Mr. Aston Key. It occurred in an apparently healthy lady of thirty-two years of age, and made its appearance during the period of her pregnancy, and within six weeks of her confinement. The skin became involved; the whole breast assumed a marble hardness; and then the other breast became similarly affected. An operation was deemed inadmissible by all parties. She died within six months, with effusion into the cavity of the chest, in confirmation of the observation of Sir Benjamin Brodie on this subject.

Cases for rejection in breast.

We reject operations for the removal of tumours of the breast that are probably malignant in character when marked by constitutional disturbance, by large size, by rapid growth, by indefinite outline, and by considerable enlargement of the axillary glands. If the disease has advanced to the ulcerative stage, it is an additional element of objection, especially if the exposed surface of the tumour be large, and the secretion from it great. In defined tumours forming in the substance of the breast of apparently healthy persons, unaccompanied by enlarged axillary glands, or by much pain, of slow growth, including all the varieties of simple tumour, and even in that of the chronic form of cancer, when under the most favourable circumstances, we are, I consider, justified in operating. Before the removal of diseases supposed to belong to the malignant class, it is the duty of the surgeon to conceal nothing from the patient or from her friends, but to state openly the liability of the disease to return. The motive for removal is founded on the supposed probability of a longer extension of life, with the operation than without it. But even this is a question in many cases of serious doubt, and I can only enforce the necessity of the most deliberate reflection, and no less of forbearance, when I assert that operations for diseases of the female breast become less and less frequent in proportion to the age and experience of the operating surgeon.

Cases for operation.

Resort to the knife limited by experience.

Removal of the entire gland.

A question has been canvassed, founded on the necessity of removing all or a portion only of the mammary gland, in true scirrhous disease of the organ, or in suspected cases of that disease. If the morbid growth be insulated and moveable, and the texture of the gland around be unaltered, if the tumour be small in size and give no evidence of being connected or identified with the otherwise healthy gland, and being deeply seated is unconnected to the skin, it does not appear to me necessary or desirable to remove any portion of the gland, but that which immediately surrounds it; at the same time there is high authority for the opposite practice. Even if it be identified with the gland immediately around, but still leaving the organ to all appearance otherwise healthy, I do not think any important object is answered by the removal of the entire gland, provided the operator cuts wide of the disease. In cases in which the removal of the entire breast appears requisite, perhaps the sounder decision would be one unfavourable to the operation at all.

Operation.

The size and depth of the tumour being ascertained, the lines of incision should be previously calculated.

These incisions should include so much of the integument as will permit of the ready removal of the tumour, and leave sufficient skin behind to cover at least the larger part of the wound. The direction of the lines of incision will depend on the position and form of the tumour, nor is one direction much preferable to the other; it may be made oblique, vertical, and transverse. The chief ground of preference relates to the facility of dressing hereafter. If the nipple be not involved in a case occurring in early womanhood, I see no justification for its removal. The arm should be moderately extended, unless by being brought to the side it enables the operator to grasp the tumour in his hand, and draw it off the pectoral muscle. It is of no importance which incision be first made, whether the upper or the lower, the inner or the outer. The rule formerly prevailed, giving priority to the lower, lest the flow of blood from the upper should obscure the line of the lower incision; but this is not an operation of dissection.

Knife.

The knife employed should be a large and strong scalpel, with a thick and firm handle. The first incision in most cases should be carried at once through the gland, nearly down to the pectoral muscle, on one side of the tumour, and the second, beginning at the point of junction above, should sweep round on the opposite side. The tumour should be grasped firmly by the hand, and detached from the muscle along its base by a few strokes of the knife. The entire operation does not require more than a minute, and may often be performed in less. There is no excuse for cutting deeply into the pectoral muscle, when the tumour is moveable upon it; when adherent, the surface of the muscle should be removed to the full extent of the adhesion.

Time occupied.

The old operation, which consisted in the elaborate dissection of a tumour of the breast, on which occasions half an hour or longer time was required to complete it, is all but exploded, and with great reason. I have known one hour and three-quarters devoted to a single operation for the removal of a common tumour of the breast. The wound should be rendered entirely free from bleeding before its sides are brought together. These may be united partly by suture and partly by plaster, and a compress of cotton wool will complete the operation.

# CHAPTER XIX.

## ON BURSÆ AND GANGLIONS.

Natural and adventitious.

BURSÆ are either natural or adventitious. In many or most of the salient points of the body, in the neighbourhood of which the skin is connected to bone beneath, by means of cellular tissue of a peculiarly loose texture, the frequent application of an irritating cause, such as friction from a weight moving upon it, has the power to convert the cellular tissue into a cyst, having all the characters of a natural bursa. These formations are occasionally found in persons engaged in carrying weights, to occupy the whole line of the spine of the scapula and the acromion process ; and, indeed, many of these affections are adventitious that are classed, as I believe erroneously, among the natural bursæ. On the same principle we have the frequent development of one or more cysts along the line of tendons, whether on the back of the wrist or hand, or on the dorsum of the foot.

Supposed irritability of bursæ.

These swellings are both unsightly and inconvenient ; moreover, they are often a source of pain and of obstruction to the free action of the part with which they are connected, and the necessity for their removal requires the aid of operative surgery. Bursal sacs have long possessed the repute of great irritability. The records of surgery point to this fact, and have impressed the minds of modern surgeons with fear from violence done to them. How far this apprehension be well or ill founded, is, I think, a question not finally disposed of by the authority of the profession. When we consider the comparative infrequency of the resort to operative surgery during the last century, from which period the principle I allude to may be dated, when dictated by our obedience to venerable authority, the tendency in the mind to mistake age for experience, and to attach an importance to the impressions of our early life; may we not reasonably pause and suggest this question, like many others which have descended from our fathers, viz., whether the reputed irritability of bursæ is quite as great as it has been represented?

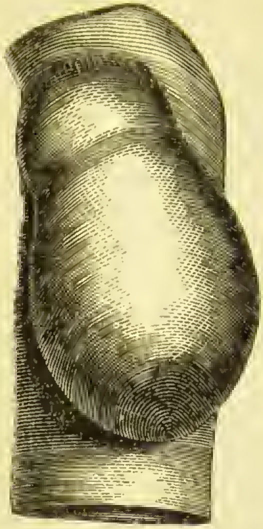
My impression is, that we have adopted the fears of the old school of surgery, forgetful of our own enlarged powers of treatment and our improved knowledge of the economy of the body. I have seen sufficient to enable me to bear testimony to great severity of symptoms attendant on an irritated bursa; but I have not seen, under opportunities as extensive as fall to the lot of most men, evidence of that peculiar liability to inflammation and its consequences, sufficient to justify the traditional susceptibility furnished by the history of the past; nor have I seen its occurrence with such frequency as to impress my mind with the conviction of the greater tendency of bursæ to inflammation than any other simple texture; though I am ready to acknowledge, that when a bursa is highly inflamed, its actions are often more than ordinarily violent.

Communication with joints.

The communication of bursæ with a neighbouring joint, is an occasional, but not so frequent occurrence, as supposed. We have such an instance in the bursa underneath the subscapularis muscle opening into the shoulder-joint, and it is almost the only example found in the healthy body. Certainly the bursæ under the psoas and semi-membranosus muscles do not often communicate with their respective joints. The small sacs found on the line of superficial tendons, and known under the name of ganglions, I shall consider separately.

Form, size, &c.

The most common form of this disease requiring treatment is that on the patella, and known under the name of the housemaid's bursa. It is caused by kneeling, and is, I believe, more frequently an adventitious than a natural formation. It assumes, when diseased, the form of a rounded swelling, varying in size from that of a walnut to that of an orange, and is exceedingly inconvenient from its locality, and is often, though not very generally, found on both patellæ. The accompanying sketch shows the enormous size it may sometimes attain. The skin covering them is pale, and the tumour underneath may present any degree of density, from that of a soft fluctuating cyst, to a firm fleshy substance. In the first case, the contents of the sac are serous; in the second, the diseased actions appear to have expended themselves in the heaping up of a thick, dense, fibrous wall, surrounding an exceedingly small fissure-like cavity in the centre, which is generally empty of fluid.



Structuro.

Former treatment inefficacious.

These tumours have sustained a tolerably long contention against treatment by leeches, blisters without number, and liniments in every variety, and will be generally found to have come off victorious in the struggle. Excision has been resorted to, from the effects of which I once traced the body of a poor girl into the dead-house. It was an operation of expediency. (*See* Introductory Chapter.) I may assert with truth that I have treated at least a hundred cases with success, and generally without being attended with the loss of more than a few days' work to the subject of the operation.

Treatment by seton thread.

The principle of this treatment consists in promoting suppurative action in the sac, and of converting the torpid growth into an abscess. This is effected by passing a single full-sized thread by means of a straight needle through the body of the tumour, and through the cavity in its centre, if the tumour belong to the hard and most chronic forms. My directions, when given to hospital dressers, are to require the thread to be withdrawn at any time, should positive pain or inflammation arise. The general average of time requisite is about four or five days, when a blush of inflammation appears about the orifices of the thread. If the thread be allowed to remain more than a day or two after this period, if the instructions be neglected, or the patient indulge in violent exercise or active motion, the inflammation will extend and assume the character of erysipelas, and an attack of illness is inevitable.

Unless the patient be seen each day, the order to remove the threads on the occurrence of pain, &c., should be imperative. This application converts the fluid containing cyst early, and the hard, and more solid tumour somewhat later, into an abscess. The abscess is opened, or bursts if neglected, and the cavity and substance altogether are obliterated.

Converted into an abscess.

The same treatment may be applied to bursæ on the olecranon, and in any part of the body in which the disease is placed immediately underneath the skin.

A large bursa is found under the insertion of the semimembranosus muscle. When the knee is bent, the tumour rolls under the tendon, which conceals it from observation. On this account it has been supposed that its fluid contents passed into the knee-joint. When the knee is straightened, the tumour stands out prominent and hard. I have known this bursa to contain from twelve to fifteen ounces of fluid. In passing a thread through this and similar sacs of large size, I should keep the patient at rest in the horizontal posture, and withdraw the thread early.

## GANGLIONS.

These small sacs form about the back of the wrist and fore-arm, and also on the foot and about the ankle-joint. I have seen two cases lately of the same disease occurring at the root of the thumb, by which the radial artery was raised, and supposed to be aneurismal.

The common practice is to break the sac with a blow from the back of a book. Unfortunately the operation is often unsuccessful both at the moment, and in future. The blow is struck, causing severe pain, and the sac is unbroken, and even when broken and the fluid contents infiltrated into the cellular tissue, the sac often heals and the disease continues its career of annoyance as before. I have rarely, though I have occasionally, failed to cure ganglions, when placed immediately underneath the skin, by making a simple puncture with a fine lancet. The lancet employed, which should be somewhat beyond

Treatment.

the ordinary breadth in the shoulder, and short in the cutting edge, is passed slowly to the bottom of the cyst, and then turned a little in the fingers, to dilate the wound. The opening must be sufficiently large to allow of the escape of *every drop* of the albuminous fluid contained within it.

The sac is then to be firmly compressed by plaster drawn tightly over a small pledget of lint, and a roller applied, and in two days the disease is cured. If any of the contents remain in the sac, the sides cannot be brought into contact, and the disease will return. If the puncture fail the first time, I have found it generally fail the second. Under such circumstances I have recourse to the thread, and should this be unsuccessful, we have no alternative, but that of laying the sac entirely open or of removing it altogether.

Sac burrows under tendons.

It is only recently that I have obtained some explanation of the cause of failure of the operation by puncture in destroying the ganglion of the wrist, or elsewhere. In the early stages of the disease, the sac is placed upon the tendon, and limited to the tissue lying between it and the skin above. But later in its progress, and particularly after the resort to pressure, the sac extends around, and beneath the tendon to its under surface. If the sac has thus extended itself, it is exceedingly difficult to evacuate its contents by the pressure of the finger; a few drops may yet remain to separate the walls from each other. If such a tumour be evacuated, it is almost impossible to retain the opposing surfaces in such apposition as will insure obliteration. The slightest movement of the hand and fingers detaches the surfaces from each other, and the disease returns. If it were practicable to avert this liability, to place the hand in a splint, and to make very considerable and very inconvenient pressure on the sac, I imagine the end would be obtained. When, having otherwise failed, we resort to the expedient of removing the cyst by the knife, care must be taken not to dissect the exposed tendon unnecessarily, otherwise permanent adhesion between the tendon and the skin will follow.

Bursa under annular ligament.

Collections of fluid occasionally occur in the bursæ placed between the flexor tendons of the wrist and the anterior annular or carpal ligament. The loose texture of the walls of this cavity permits great distension of the sac, which enlarges upwards above the carpus and downwards into the palm. Fluctuation is perceptible in both situations, and the communication between the two is sufficiently distinct on pressure. These collections often contain a large quantity of bodies resembling small melon-seeds, the presence of which would alone preclude the hope of benefit from the introduction of the thread, although other reasons might be assigned for the rejection of this remedy. In some cases the sac is enlarged in the direction of the ball of the thumb, and fluctuation may be felt as far back as the first dorsal interosseous muscle. The attempt to cure this often intractable malady should consist in a free puncture, made above the wrist. The contents carefully and entirely evacuated, and the hand bound up firmly by the aid of plaster tightly drawn over a thick pad of lint, and retained with more or less pressure for a week or ten days, the most perfect rest being at the same time strictly enforced on the patient, inasmuch as the slightest movement of the fingers may prove fatal to recovery. Should the disease return, the sac on second operation may be injected with a weak lotion of tincture of iodine. When all other measures fail, the sac may be laid open by a free incision mado above the wrist, but it is not necessary to expose the entire cavity. If an opening of an inch or more in length be made, and the contents pressed out, a piece of lint may be introduced into it, by the presence of which suppuration will be established, and the cavity will be ultimately obliterated. The incision should be made above the carpus, and at the most prominent part of the swelling.

**Free incision.**

Mr. Savory has lately treated with success the protracted case of our porter belonging to the Anatomical theatre, who has suffered from this malady for many years. The treatment consisted in the continued application of a poultice made of the scraped root of the common black briony (*Brionia dioica*), followed, when the sac no longer gave evidence of any fluid within, by infrications of camphorated mercurial ointment and starched rollers. At the expiration of some twelve months it would appear that the contents of the sac have become absorbed.

# CHAPTER XX.

## OPERATIONS ON THE CRANIUM FOR DEPRESSED BONE.

WHEN a cranial bone is depressed, and requires elevation by the surgeon, with a view to obviate the consequences of certain symptoms indicating pressure on the brain, we have occasional recourse to the use of the trephine. To the modern improvement in mechanics may probably be attributed the rareness of these cases of fracture, that formerly were so abundant in our London Hospitals. We resort to the trephine in cases of depressed bone, attended by symptoms of compression of the brain, and occasionally, the depression of bone being very considerable, without symptoms. It is also employed for the purpose of exposing the membranes of the brain under various circumstances of suspicion of the presence on or under the dura mater, of either extravasated blood or matter. An instrument often resorted to is a small saw, first employed by Mr. Hey, of Leeds, and bearing his name, and of which there are various modifications of form and size far more convenient and more efficient than the old circular saw. The operating surgeon should possess several. They will be found serviceable not only in reference to injuries of the cranial bones, but also to operations on bony structures in other parts of the body.

Trephine.

Hey's saw.

The grounds on which the employment of these instruments for elevating depressed cranial bone is placed, are the presence of symptoms of compressed brain following an accident. Without the accident, always ascertainable, we have no ground for the suspicion of depressed bone. After an accident, with the usual symptoms of loss of sensibility, more or less stertor of the respiration, a labouring pulse, a pupil deviating from its natural size, but generally inclined in the direction of enlargement, we are required to cut down and expose the bone.

Symptoms of compressed brain.

The necessity for the interference of operative surgery is differently estimated by different authorities. We may have symptoms without fracture, and fracture without symptoms. Mr. Abernethy and Sir Astley Cooper justify the refusal to operate on the bone, almost to whatever degree depressed, provided the depression be unattended by the above symptoms. On the other hand, Mr. Pott and his predecessors consider the presence of depressed bone, although unattended by symptoms of compression of the brain, to be a full justification for interference, and in this view Mr. Guthrie concurs, believing that, although the evidence of injury to that organ be not manifest at the time, yet that the evil is only masked for the moment, to appear in a more formidable character hereafter.

Warrant for interference.

The part is often readily discovered by the presence of ecchymosis, or by other indications that are unequivocal, and through which an incision may be made in any direction. If through the temporal muscle, the muscle must be sacrificed by cutting across its fibres, if necessary; the value of the muscle is as nothing compared to the urgency of the case, though the old authorities appeared to have thought otherwise. The temporal artery should be avoided, if possible; but every supra-cranial structure must be sacrificed to the necessary exposure of the bone. When exposed, the line of fracture should be followed to an extent sufficient to command it with facility. This may be effected by a second incision at any angle with the first. When the bone is fully exposed, and the introduction of the elevator is prevented by the wedging in of the bone, a portion of the adjacent bone must be removed, for the purpose of making room for its introduction. This will be best effected by a short saw, either by that invented by Mr. Hey, or by some modification of it.

Trephining.

In the operation of the trephine a small but strong instrument should be selected, and especially so for purposes of mere exploration. When employed for that of raising depressed bone, the circle is so applied as to cut into the fissure formed by the fracture. The centre pin should project beyond the line of the saw to the extent of about two lines, and a hole bored in the bone at the distance of the semi-diameter of the instrument from the fissure, or if the bone be much depressed below the surrounding level, a segment only of the circle may be removed. The office of the centre pin is that of steadying the trephine on the bone until the groove is sufficiently deep to retain the saw in its position.

In the rotatory movements of the instrument care should be taken that it be held quite vertically to the plane of the bone, and when in action that the saw be made to bite the bone both in the movements of pronation and supination, otherwise the groove will become imperfect and unequal in its depth. When sufficient depth has been obtained, the centre pin may be withdrawn, and the operation of dividing the bone may proceed. The movements of the hand should be slow, firm, and steady. As the groove becomes deeper, it should be examined frequently by the aid of a probe, and when we have reason to believe that we have penetrated fully beyond the diploe, we should employ an elevator, and endeavour to detach the central portion, using it as a lever of the first kind. It is not advisable to complete its removal by the saw, but rather to rely on frequent examination with the probe on the use of the elevator as a safeguard against injury to the dura mater. When the bone is removed, the elevator is introduced into the fissure, and the depressed bone raised, by making a fulcrum of the adjacent sound bone, or of the hand. It is advisable to restore the integument to the wound if possible.*

Elevator employed as a lever of the first kind.

## RHINOPLASTIC OPERATION.

We are sometimes called on to remedy the distressing deformity occasioned by the partial or total loss of the nose, whether from disease or accident, by the operation of rhinoplasm. When the nose is entirely destroyed, the openings of the meatus are completely exposed, conveying a most offensive expression to the observer, which the resources of art alone can remedy, or at least ameliorate. No condition of face can perhaps be more repulsive than that in which the eye at once penetrates, the commonly hidden organisation of the nose and fauces, except, perhaps, that compound of evils which results from a total failure of the attempt to remedy it. And such is usually the consequence of a first ill-planned, unstudied operation, which has for its object the imitation by art of the form and outline of the natural organ. There is no operation in surgery that requires more calculation and careful study than this. The surgeon should pay many visits to his patient for this express purpose. No execution can be satisfactory, the design of which is imperfect. It exhibits the height of ignorance of the Taliacotian art, for a man to take the knife in his hand with the intention of supplying so serious a loss as the human nose, who has not planned his operation in all its points with the utmost precision, and determined on the minutest detail. Without such care failure is certain, and the result inevitable; the patient is disappointed, and with reason, and the surgeon is stigmatised as worse than ineffective.

---

* The late Mr. Mitchell, of Redruth, operated with the trephine on nearly 200 patients. Mr. Mitchell considered the operation to be comparatively free from danger.

**Operation succeeds as it is well planned.**

**Structure.**

The nose is partly bony and partly cartilaginous. The lower half, or rather more than half, is composed of several portions of cartilage, two of which form the outline of each nostril, and two above, the alæ; a fifth cartilage forms the lower and anterior part of the septum nasi, and the lower edge of the septum is called the columna.

The disease to which the destruction of the nose may be usually assigned, is *lupus*, which having involved the cartilaginous structure, leaves the bone untouched. Occasionally the ossa nasi are also destroyed; and I believe we may then often infer that such a patient has employed mercury largely, for supposed syphilitic or venereal disease. If the bones be entire, the operation is more likely to be a successful one. If the bones be destroyed, the condition of the patient precludes the resort to the best operation, and the result is far less promising, from the loss of the arch on which the superstructure is laid.

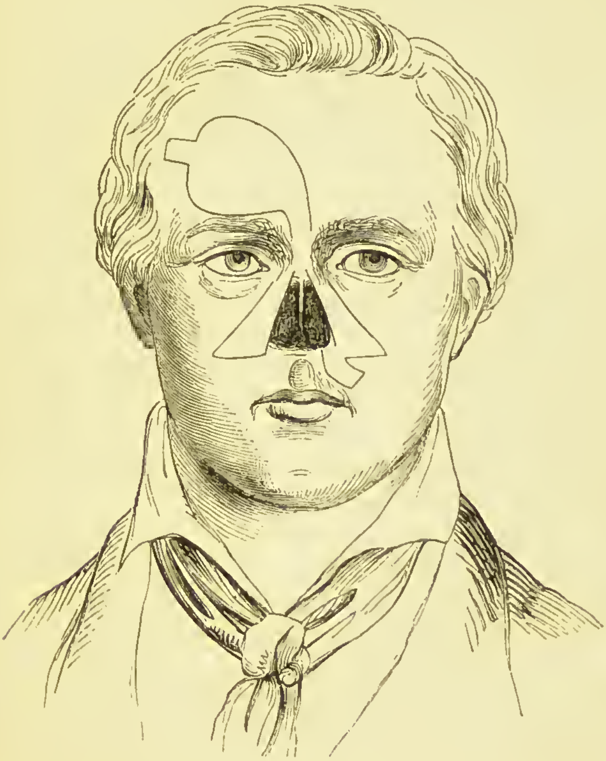
The rhinoplastic operation should be solicited by, and not forced or even urged, on a patient. Without the employment of chloroform its performance is attended with great pain, which should be duly represented to the person, as likewise the duration of the operation, which is necessarily a very protracted one. No attempt should be made until all disease has ceased for some months. And yet, on the other hand, I made a nose for a young woman having the last vestiges of lupus still hanging about her face, and the case turned out excellently well, so well, indeed, that Sir Astley Cooper told me it was the best nose he had ever seen.

Flap from the forehead.

Before proceeding to the operation, the dimensions of the required organ should be carefully made in card or paper. The new material is taken from the forehead, and connected on the root of the nasal bones by a narrow stalk-like process. When the flap of integument is insulated, this stalk is twisted, so as to enable the part to be brought down vertically. The integument should be removed longitudinally from either half of the forehead, running out towards the temple, in order to render the twist as inconsiderable as possible; and when the admeasurement is completed, at least a quarter of an inch on all sides should be allowed for the contraction of the skin. In fact the flap can hardly be made too large; and it is surprising how slight a stalk is requisite to carry on the circulation. When the card has been fitted over the meatus, it should be laid out on the forehead, and all its dimensions extended and marked in ink. The part that is to represent the columna, should be very broad, probably more than half an inch.

Operation.

The operation, which is performed nearly in the horizontal position, is commenced by paring the margin around the nose pretty freely, in order that the exposed edge should be sufficiently large to receive the corresponding margin of the new integument, and the skin on the lower surface of the ossa nasi should be entirely removed by the knife. When this stage of the operation is completed, a deep incision should be made along the inked line on the forehead, slowly and cautiously, for one slip of the knife may render the whole operation nugatory. The lower edge of the incision will pass across the fibres of the corrugator supercilii, which muscle may be detached with the integument. If the knife be so held as to slope a little inwards, it will give an acute angle to the cutaneous surface of the flap, by means of which the two surfaces may be adjusted with more precision as regards the continuity of surface. When the flap is detached in every part except at the stalk, which of course is most carefully preserved from injury, the wound should be left to bleed, and no attempt made to adapt the surface until the bleeding has *entirely ceased.* Before



leaving the flap, it is better to scoop out a little of the substance along the central line of the columna, in order that, by being hereafter compressed, it may fold together, and resemble as much as possible the original structure. When brought down, the columna should be first united to the raw surface made for its reception. There is some difficulty in applying the suture in this situation, from the density of the structure forming the base of the nose. For this purpose, a much-curved needle should be employed, which should embrace a considerable piece of the cartilage. It may be advisable to employ two sutures, instead of one. The sides are then first united by about three good-sized sutures, and the intervals as

Columna.

To be first adjusted.

exactly adjusted as possible, by the aid of six, eight, or ten of the finest sutures that can be employed. The nostrils should be elevated by means of pieces of cork and cotton-wool, and general pressure of moderate force made laterally with the same material, and a bandage; care being taken to prevent all pressure on the dorsum. The wound on the forehead should be drawn together with good plaster. At the expiration of about a month, or as soon as the new parts have firmly united, the lump always caused by the twisting of the stalk should be pared away, and the knife applied to remedy any positive deformity in the line of the cicatrix. I have done this operation many times, and, except on the first occasion, with some success. In two cases the deformity was so completely removed, that even the companions of the individuals never suspected that they had been the subject of operation; and this success I attribute to care and deliberation in the performance, and to the exact adjustment of the edges of the wound, by means of the finest needle that I could have made, compatible with sufficient strength to resist the force requisite to penetrate the skin and cellular tissue.

Fine sutures.

Shrinking of new structure.

It will occasionally happen, after some days from that of the operation, that the new structure begins to lessen in size, and continues to diminish, till it becomes almost absorbed. My experience in nose making, though not small, is not sufficiently great to enable me to explain this fact, whether owing to the small size of the stalk, or to the want of general activity in the circulation—but such is the case.

I had at one time two cases of rhinoplastic operation in St. Bartholomew's Hospital, a young man and woman. They occupied two opposite wards on the same floor; became much interested in each other's case, and exhibited some sentimentalities, which led to an offer of marriage by the man. The girl had undergone the operation with success—the issue of the man's case was prospective. The girl did me the honour to make me her confidant, and to ask my advice. I told her to wait the result of the operation on the other case. She did so; and finding the new structure to have undergone the change I have alluded to, she declined further intimacy.

In cases in which the ossa nasi are destroyed, the

Two lateral flaps.

operation consists in bringing to the mesial line two lateral flaps made from the side of the nose upon the cheek. The calculations in this operation are nearly as important as in that last described. The outline of the nose is to be prepared, as in the former operation. An incision is commenced at the root of the nose, as nearly as possible on the dorsum, and carried down as close to the line of the former organ as the condition of the skin will permit, and a second, commencing about half an inch on the outer side, should extend downwards, curving at the same time a little outwards, to avoid the orbicularis muscle. The second incision should diverge from the first towards the cheek-bone, and at its extremity, which should correspond with the line formed by the base of the nostril, should be distant more than a full inch from it. It is desirable, if practicable, to make the columna at the same time, and it may be effected by carrying the first incision at its lower extremity inwards, at right angles with the vertical line, to the extent of a quarter of an inch, and then continuing the line downwards and outwards above the angle of the mouth, to the extent of three-quarters of an inch. A second line, commenced half an inch outwards, is to be carried upwards into the line which forms the base of the triangle, to complete the columna. The two descending lines may then be united, and the same process adopted for the other side, with the exception of the additional process required for the columna, which is made entirely from one side. If made from both, probably it would not retain its vitality. It seems to me that this attempt to form the columna, when practicable, is preferable to that formed hereafter from the upper lip. Should it fail, the lip may yet serve our purpose. The two flaps should be separated to some depth from the surface beneath them, and brought to the mesial line, along which they are to be united by suture, and the outer edges adjusted to the bared edge already made to receive them.

Columna attached to one flap.

All these operations should be performed with a very thin-bladed knife, so much depends on the neatness and precision of the lines of incision. The nostrils should be retained by cork or other suitable means of rendering them permanently patent; this is one of the chief difficulties consequent on the operation. The wounds in the cheek should be brought together by plaster, and the eventual deformity from this cause is comparatively little; it is, however, something worthy of consideration, in calculating the advantages of one or other operation, as is also the injury done to the muscles of the face. In injuries of the nose of lesser degree, sufficient material is obtainable around from every side, to remedy the defect, if well selected. Small flaps may be raised from the cheek, after the manner recommended by Mr. Syme, and adapted with all nicety to the surface to be filled up.

## POLYPUS NASI.

Two principal forms.

There are two forms of polypus nasi requiring the aid of operative means for their removal.

First, the benign gelatiniform polypus of the nose, which is known by its whitish colour and shining aspect, protruding into the nostril, and generally lying between the inferior spongy bone and the septum nasi. It is destitute of pain, and is very imperfectly supplied with vessels. It is affected much in regard to its dimensions by the state of the weather, contracting in a cold and dry atmosphere, and becoming relaxed, and descending low in the nostril, in moist. It can therefore be more readily removed in the latter.

Secondly, the fleshy polypus is a growth occupying one nostril only, whereas the former disease may appear at the same time in both. As its name denotes, it is more fleshy in its aspect, and it is more active in its growth than the former disease, occupying the entire cavity of the nostril, from which it proceeds in a large fleshy secreting mass. The nostril is often largely dilated, affecting the expression of the entire face. When handled roughly it bleeds freely; for though apparently not very vascular to the eye, it contains large vessels. Its root is probably from the outer and upper side of the nostril, which it is impossible to reach with any certainty. Although not malignant, it possesses some of the attributes, at all events the appearance of malignancy.

The most common mode of detaching the gelatiniform polypus is by the aid of forceps of different shapes, suitable to the aperture which they are required to enter. Sometimes the growth is sufficiently firm to be detached entire at the first attempt at extraction, and the whole polypus comes away from its root, but more frequently we are required to extract it piecemeal, in consequence of its readily breaking up under the necessary extension and pressure of the forceps. When entirely removed, to all appearance, polypi of the nose are yet liable to return. The plan I adopt, in regard to soft polypi, is one which often affords a more efficient result than that obtainable by the forceps. It consists in passing up a loop of fine copper or iron wire, or of silkworm gut, through a double canula. The form of the loop and the size are adapted to that of the aperture through which it has to pass. This loop is carried up the nostril, embracing the growth, and manœuvred around its base by a gentle movement of the hand, and the wire is then drawn tight. By this mode I have often included so much of the polypus as to afford great and immediate relief to respiration through the nose. I have obtained occasional relief by pressure, from the application of lint or cotton wool forced into the nostril by means of a director. Whichever of these agents is employed, it should be threaded, by a piece of thread or silk passed through it, to facilitate its entire removal.

Extraction.

Loop of wire.

It rarely happens that the attempt to remove the fleshy polypus by forceps is successful. The substance breaks down, and the hæmorrhage is often very great. Before attempting its removal, the extent of the disease should be carefully examined by means of a probe or director being passed around it. The finger should be introduced behind the soft palate to ascertain the extent of the growth in the posterior direction. If the growth be large and the nostril much distorted, it will simplify the operation greatly if the nostril be divided as high as the os nasi on the affected side, and the inner surface reflected off the tumour. The forceps may now be applied much closer to its root, and will probably embrace it. In order to avoid the hæmorrhage, which is often enormous considering the size of the growth, the loop of wire or of silkworm gut may be employed, in place

Silkworm gut.

of the forceps, and the tumour strangulated, by including it in the loop drawn as tightly as possible. It will occasionally happen that the root of a fleshy polypus is connected so far back in the nostril as to render the growth dependent almost entirely within the cavity of the pharynx. When so connected, the pressure on the soft palate is such as to force it downwards almost in a vertical direction, and nearly to reach the level of the tongue. The extent of the tumour should be fully examined by the finger, if possible, passed around it on every side. The free division of the soft palate will be required previous to its removal. This disagreeable operation should be performed under chloroform, and in the upright posture of the patient, in order to prevent the blood gravitating into the throat, a very troublesome occurrence both to the patient and the surgeon.

## PLUGGING THE NOSE IN EPISTAXIS.

In serious or protracted hæmorrhage from the interior of the nose, we are compelled to resort to the operation of closing the entire orifices of the cavity, both in front and behind. These orifices consist posteriorly of the two rectangular spaces by which the cavity of the nose communicates with the upper and anterior part of the pharynx, and separated from each other by the partition of the vomer, and anteriorly by the orifices of the nostrils, each being surrounded by the oval ring of the lateral cartilages, forming its patent margin. The operation for plugging these four openings is a disagreeable one both to the patient and the surgeon, and is only resorted to under circumstances of necessity, that necessity being determined by such hæmorrhage as fails to yield to other and ordinary remedies. The remedies may be concisely stated as follows :—The repeated application of cold water to the person by sudden douche, a large jug full being suddenly thrown either on the head or on the trunk. The injection of strong solutions of alum, of matico, of tannic acid, of sulphate of iron, or the application of the perchloride. One or more of these or other similar agents may be resorted to while the patient is confined to the upright position of the body. The syringe employed for the purpose should be sufficiently large to convey into the nostril a full stream of the solution, in order to ensure its coming into contact with every part of the irregularly formed cavity, and it may be repeated two or three times on each occasion of its use. Should these measures fail, it is better at once to proceed to plug the cavity. The blood, should it continue to flow, being confined within the cavity of the nostril, becomes the immediate agent of pressure on the offending vessels, and the hæmorrhage, of necessity, ceases.

Operation.

The first step in the operation consists in the preparation of a conical plug of soft lint, from an inch and a-half to two inches in length, of about the thickness at the base of an ordinary-sized thumb. To this plug a long ligature of thick silk thread is affixed by passing the silk, with the aid of a large needle, in at the apex of the cone, and bringing it out at the side about half-way down, tightly encircling the plug, and tying with a single knot, re-introducing the needle at the point of its emergence from the cone, and once more bringing it out in the centre of the base. From the apex about twelve or fifteen inches of ligature, and five or six inches at the base of the plug will suffice for the operation. The plug should be oiled.

The second step consists in passing a ligature through the affected nostril and into the mouth round the soft palate. This is readily effected by the spring instrument invented for this purpose, supposing it to be at hand; but if not, the end may be attained without difficulty, by passing a small gum catheter along the same track, to the end of which is securely fastened a piece of strong silk thread of a foot or more in length. The catheter, rendered flexible by immersion in warm water, is passed along the floor of the nostril, till, reaching the back of the fauces, it is curved downwards by continued pressure by the hand, and when it comes into view from the mouth, the silk should be seized with a blunt hook, in preference to forceps, drawn forwards through the mouth, and the catheter withdrawn. This part of the operation should be effected with as light a hand as possible, as it causes considerable distress to the patient. The plug is now attached, apex upwards, to this thread by a firm knot, and drawn into the mouth by the silk hanging from the anterior nares. It should be carried rapidly over the tongue, and passed around the palate by the aid of the forefinger of the operator, while considerable tension is exerted upon the ligature through the nose. When it has reached its destination it may be drawn tight by the movements of the hand, in as various directions as the capacity of the anterior nares will permit.

The anterior orifice is now to be plugged by the following process ;—The front ligature is firmly tied to a small roll of lint placed transversely to the thread, of an inch in length and half an inch in diameter, as close to the nostril as possible. Around the piece of silk intervening, between the roll of lint and the orifice of the nostril, a strip of lint of four or five inches in length is to be coiled, the breadth of which should rather exceed the length of the silk exposed. By means of this coil thickly made around the silk, a portion of which will fall within the margin of the nostril, the opening will be effectually closed, while it maintains a continual drag on the posterior plug, and insures its entire contact with the walls of the opening behind. When the nostril is carefully closed by such means, there can be no objection to the administration of such medical or dietetic remedies as may be desirable, with a view to restore the lost blood, or to avert the possible consequences of serious hæmorrhage in a debilitated constitution. The plug, unless very irksome, may be removed by about the third or fourth day, after which its presence becomes a source of considerable annoyance to the patient by the irritation it excites in the nose and the adjacent parts of the face.

## HARE-LIP.

On the more or less perfect result of this operation depends the appearance and expression of the individual for life. Hare-lip may be simple, affecting the lip only, or complicated by defective bony organisation of the palate. In the first form we have a simple fissure : in the second, we have in the interval of the fissure a small projecting process of the superior or inter-maxillary bone, covered by a thin skin, and the fissure extends upwards

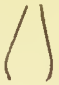
Varieties.

into the nose. This piece of bone must be removed before the attempt be made to obliterate the fissure, and may either be detached by the forceps, or forced backwards by partially separating it behind by the same instrument. I have attempted this on two occasions, but not with much success.

Age.

Operation.

The operation for hare-lip may be performed at almost any age. By some surgeons it is performed at a very early age, but I doubt the advantage of its being undertaken at a period earlier than three or four months. The surgeon should first ascertain that the opposite surfaces will readily meet without effort. If force be required for this purpose, the lip will be required to be detached from the gum to the extent of three-quarters of an inch or more on each side. An incision is made at a distance of about the eighth of an inch or even less from each edge, removing all the intervening integument, and forming two flat surfaces for future contact. In consequence, however, of the greater extensibility of the lower than the upper part, the result of the operation for hare-lip, is to leave a permanent deformity, caused by the retraction of the cicatrix, and the formation of an angle below, at the point of union. To obviate this evil, the lines of incision should be curved inwards. This incision may be made either from the nose downwards, the portion to be removed being firmly held by a fine pair of forceps, or the structure may be transfixed by the knife at a point about two-thirds from above at the time at which the direction of the incision is made to incline inwards. The separation is then continued in each direction. A fine scalpel is the best instrument to be employed for this purpose, with which the incision should be dexterously and cleanly made. When these two edges are brought into contact, the upper lip will be found to project downwards in the centre, and this evil, time will rectify, by bringing the surface of the lip into a straight line. The necessity of removing a larger portion of the lip by this than by the straight incision, is a small objection only, for the extensibility of the material will readily admit of contact, and that is all that is required. Young operators are prone to remove too little.



Angle of incision to be avoided.

Bleeding.

The bleeding from the coronary arteries is sometimes considerable, but a ligature is, of course, inadmissible. The opposite surfaces being adjusted with the greatest precision, are fixed by means of two needles, which should be passed by means of a port aiguille through *nearly the entire substance* of the lip. The point of introduction is from one-third to one-half an inch from the cut surfaces. A thick silk thread is passed across and around each needle in the figure of eight. It is not desirable to include the two needles in one and the same thread. The parts should be drawn together with sufficient force for entire contact, and the intervals between the needles, and particularly the lip itself, should receive, if necessary, one, two, or three fine sutures, to ensure the contact of the entire length of the wound. The needles should be removed with a gentle hand, if union be complete, about the sixth or eighth day, or at an earlier date, should a blush of inflammation appear around them. If union fail, but no redness of the skin appear, the needles should be retained to afford the chance of union by the second intention.—(*See* CHAPTER ON WOUNDS.)

Fine sutures.

Incisions through the lips.

In operations for the removal of large tumours on the lower gum, which require free exposure of the mouth, it is better to divide the soft parts along the base of the jaw, and to expose the tumour in that direction, than to distort the face by an unnecessary incision, adopting the plan recommended in excision of the base of the lower jaw. The skin and platysma muscle may be divided to any reasonable extent along this line, which may be even carried beyond the centre, should that be requisite ; and I should myself prefer a vertical incision made upon it, if necessary, to the consequent disfigurement of the face, incidental to an incision carried through any part of the lips.

## RANULA.

Nature of disease.

The disease known under the name of *ranula* is commonly of small size, occupying the sub-lingual region of one side, but encroaching also on the other. It consists of a sac, supposed to be formed, and not improbably so, by the dilatation of the sub-maxillary or one of the sub-lingual ducts. It presents a bluish colour, vessels are seen ramifying upon it, and it is elastic to the touch. In size, ranulæ vary between a horse-bean and a small orange. The contents consist of a transparent viscid fluid. If punctured, they fill rapidly; and, in consequence, of their great tenacity of existence, portions of the sac have been cut out, and caustic applied to the interior of the sac. When of very large size, the walls of the cyst are proportionately thick and flesh-like. The most efficient treatment consists in merely passing through the body of the cyst a needle armed with silk of moderate thickness, the silk should be loosely tied, and the ends cut off. In the course of a few days the tumour will be obviously diminished in size, and will continue to lessen till the ligature will probably be found at the side of the cyst which has contracted beyond it. The thread should be then cut and extracted, and a second thread introduced through the reduced sac, by the agency of which, it will be finally absorbed.

Treatment by seton thread.

Some years ago I attended a young lady, who had a ranula of the largest size I have ever seen. Her mouth appeared to have no cavity. The tongue was forced back against the soft palate ; she could not swallow without a great and painful effort, and even her respiration was affected ; It had the appearance of a large tumour occupying the mouth, of which the walls were firm and thick. I introduced a single coarse thread of silk through it, and in a week it was reduced nearly one-third in size, and then another, and so on ; till, at the expiration of six weeks, scarce a vestige of the disease remained.

Cases.

Within the last year I have had under my care in St. Bartholomew's Hospital two unusually large cases of this disease. In both examples the tumour presented in the neck below the base of the jaw. In one of them it had acquired the magnitude of the half of an orange in that region. Impulse between the two collections in the mouth and in the neck was very palpable. In each case I passed a needle armed with a single thread of silk from the mouth downwards, through the neck, and connected the two ends by a knot. This treatment was perfectly successful in both examples, the process of cure in one of them being completed in three weeks and the other in four.

Epulis.

*Epulis* is a disease of the gums, attended sometimes by extensive swelling of the structure, and often involving the breadth of several teeth. Its precise nature is not well known. It is considered by Mr. Cæsar Hawkins to be of a semi-malignant nature. Mr. Hawkins believes it to originate in the periosteum of the bone, and that the removal of its entire root is indispensable to the future safety of the affected person, for the accomplishment of which he recommends the employment of the actual cautery, or the application of strong nitric acid. I have never had occasion to employ the actual cautery after the operation for the removal of epulis. I have not seen the disease return in several cases in which I have scraped the bone with a strong knife.

In preternatural elongation of the *frænum linguæ,* the best mode of proceeding is to seize the frænum with a pair of forceps, and drawing it forwards, to divide it with a common pair of scissors. This affection is much less common than is popularly supposed.

## REMOVAL OF ENLARGED TONSILS.

Chronic enlargement.

Young persons of a strumous habit are subject to a chronic enlargement of the tonsils, which interferes greatly with both speech and deglutition. In order to justify their excision, the disease should be thoroughly chronic in character, and free from pain and vascularity. In this condition, they stand out from the surface in the form of two rounded bodies, of a pale colour, and marked on the surface by the dilated orifices of their mucous follicles. Sometimes they come into absolute contact, and fill the greater part of the cavity of the isthmus. Applications of nitrate of silver avail but little. Extirpation is the surest and most efficient remedy. It is not, however, requisite for the purpose of giving relief from the recurrence of past symptoms, or for the prevention of future increase in size, that the entire body of the gland be removed, a portion only will suffice for both these ends. If any remains of recent inflammation be present, or the surface exhibit in a positive degree the redness and the general tumefaction of recent inflammatory action, the operation should be postponed. This

Not admissible with inflammation.

operation is not a painful one, and is usually unattended by bleeding, unless the arch of the palate be divided.

Guillotine.

For the removal of enlarged tonsils, an ingenious instrument has been invented, called the guillotine, consisting of a flat plate of metal, with an aperture at the further end, through which the tonsil passes, and which is there fixed. A knife connected by a slide is then pressed forwards, and cuts off the protruding part. The objection to this instrument is, that it does not leave to the discretion of the operator to determine the quantity of the tonsil he wishes to remove. I prefer a knife, resembling Cooper's Hernia knife, with a blunt point, and hooked forceps, called a vulsellum. These forceps should be made without a spring in the blades, but with scissor-handles, that some force may be employed to open them, if required. If with a spring, no power of expansion can be added beyond that of the spring, which is often insufficient in the mouth of a refractory child. The tonsil of one side being seized by the forceps, is drawn towards the mesial line, and the edge of the knife applied either above or below it. Generally speaking, the incision through the tonsil is made cleaner by dividing from below upwards. Some care is often required to prevent injury to the arches of the palate, and in the division of the gland from above downwards the tongue is liable to be wounded. I have never known more than one case out of perhaps one hundred, in which I have done this operation, where hæmorrhage occurred sufficiently great to occasion trouble. If hæmorrhage follow, it is obvious either that the operation was ill-timed or inadmissible, or that the contiguous structures have been unnecessarily involved. Still, rare cases have occurred in which bleeding has continued to an injurious extent, and in such cases the hæmorrhage has been referred to an irregular origin of the tonsillitic artery from the internal carotid.

Scissor-handled forceps.

## ON STAPHYLORAPHY, OR VELO-SYNTHESIS.

Partial or complete.

Infants are occasionally born with cleft palate. This want of development may extend to the bony structure of the maxillary and palate bones, or be confined to that of the velum. The defect becomes apparent on the attempt of the child to suck, which is made with great difficulty, when the want of the continuous membrane permits the fluid to pass into the nose, from which it trickles on to the face.

Before I describe the operation for uniting the opposite sides of the velum and palatine membrane, a brief description of both the anatomy and the physiology of the soft palate will not, I trust, be deemed out of place.

Anatomy of the palate.

The palate, so called, is divided into the hard and soft. The former is composed of the palatine processes of the superior maxillary and palate bones, uniting along the mesial line, and covered by the palatine membrane, a structure of low organisation. The soft palate (the velum pendulum palati) is prolonged backwards from the arch of bone above described, to the extent of about an inch, and is composed of muscles, vessels, nerves, mucous glands, invested by mucous membrane on both its surfaces. The muscles consist of five pairs, two of which, but slightly connected to the palate, descend in the half arches that are lost below in the tongue and pharnyx, the palato-glossus (constrictor isthmi faucium), and palato pharyngeus. The other three are the levator palati, tensor palati (circumflexus), and the levator uvulæ. The levator palati, arising behind from the temporal bone, descends forwards and expands like a fan into each half of the palate. The tensor runs horizontally inwards, nearly along the bony edge of the hard palate, towards its fellow, in the mesial line. The action of the levator is that of raising the palate, and drawing it backwards horizontally towards the pharynx. That of the tensor, as its name denotes, stretches the palate in the transverse direction, and renders it firm in the act of deglutition.

Functions of soft palate.

While at rest, the soft palate falls from the bony ridge to which it is attached, obliquely backwards, in a position intermediate to that into which it may be called by the action of its various muscles, whether during mastication or in deglutition, and the vertical line. In the act of mastication it is drawn downwards by the palato glossus, till it touches the tongue, and thus forms a back wall to the mouth, protecting the glottis from the sudden escape of any particle of food. In deglutition, the opposite muscles are brought into action, and the levator, more especially, draws the palate upwards and backwards, till, by the advance of the pharynx, the two come into contact, and the cavity of the nose is shut out from the passage thus perfected below it. At the same moment, the tongue, having the morsel of food placed upon it, is closely applied against the concave vault of the hard or bony palate, the firmness of which is prolonged on to the soft palate by the tendinous structure of the tensor palati drawing outwards from the mesial line. The act of deglutition is effected by the pressure exercised by the tongue against, first, the hard, and then the soft palate, fixed by the tensor muscle.

**Eccentric movements.**

It is difficult to explain, or almost to characterise the troubled and abortive movements that accompany the soft palate, when fissured throughout its length. They certainly cannot be satisfactorily explained on any ordinary principle of muscular action. It would appear as though the combined muscles exercised the inclination to draw the two sides into contact, and, indeed, the two sides do coalesce towards the uvula in some movements, but by what agency I am at a loss to tell.* I have observed this phenomenon on several occasions.

**Entire concurrence of patient necessary.**

The operation for staphyloraphy should never be attempted much before the age of puberty. Unless the patient lend himself entirely to the surgeon, and is fully conscious of the extent of the imperfection, and possess resolution to undergo a tedious, irksome, and painful effort at reparation, the operation should not be attempted. Without the entire consent and co-operation of the patient, the best attempt would prove nugatory, and the failure can only attach discredit both to the operation and the operator, and deter others from availing themselves of the advantages afforded by a successful issue. At the same time it is very desirable that the operation be undertaken at as early an age as possible, for the period of growth is that to which we must look for restoring to the muscles their natural, or rather, of calling into action their new-born functions. I have undertaken it at fourteen, and as late as forty-three years of age, but with very different results, so far as muscular action is concerned. A perfect state of the patient's health is, of course, indispensable.

**Early period of life desirable.**

---

* Mr. Fergusson refers it to some of the fibres of the superior constrictor muscle.

Operation.

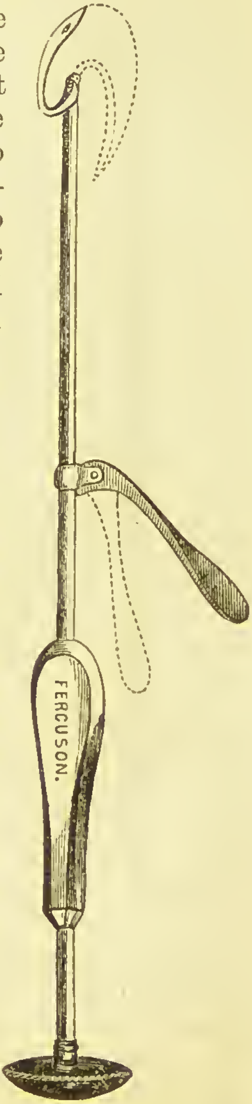
For the operation, a good light is essential. The patient should be seated in a chair on a level rather below that of the operator, and the head supported against the chest of an assistant or a nurse. The first step in the operation consists in paring the edges of the fissure. This should be effected with great nicety, and should include the entire skin, beginning at the one-eighth of an inch *higher* than the point of junction, and carried down to the extremity of the uvula, on either side. The edge removed should not be thicker than the one-tenth or twelfth of an inch, but sufficient to expose a raw surface of some line or two in diameter. This is effected by means of a fine scalpel of the smallest size. The difficulty however, does not rest with the knife, but with the forceps, for as the palate exposes its lateral edge to the instrument, it is difficult to seize it firmly. To remedy this defect, I had an instrument made with two blades of unequal length and mobility, the longer blade being reduced in substance, and moving on to the shorter one at a curved extremity. When the incisions are completed, some minutes may elapse for the bleeding to cease. The threads are to be then introduced, and of these about five is the average number required. This is the main difficulty of the operation; viz., that of returning the needle through the opposite side to that on which the first introduction was made. To overcome this difficulty, many instruments have been invented, both English and French, the principle of which consists in carrying a needle in a curve sufficiently small to return through the opposite half of the palate, at the just distance from the edge of the fissure, and at the same time to present the point directed straight forwards at its first introduction. One thing is quite certain, viz., that however perfect the instrument may be, it will be unavailable to any good purpose, unless the hand of the operator has acquired by practice a perfect mastery over it. On the dead subject the experiment may be tried, and with some advantage; but the dead body cannot represent living structure. We have no convulsive actions of the tongue, no hæmorrhage, no clinging together and confounding of threads by a glairy saliva, and without these concomitants, we cannot imitate the real operation. Another means of passing the thread, is by the agency

Difficulty of the operation.

Attendant difficulties.

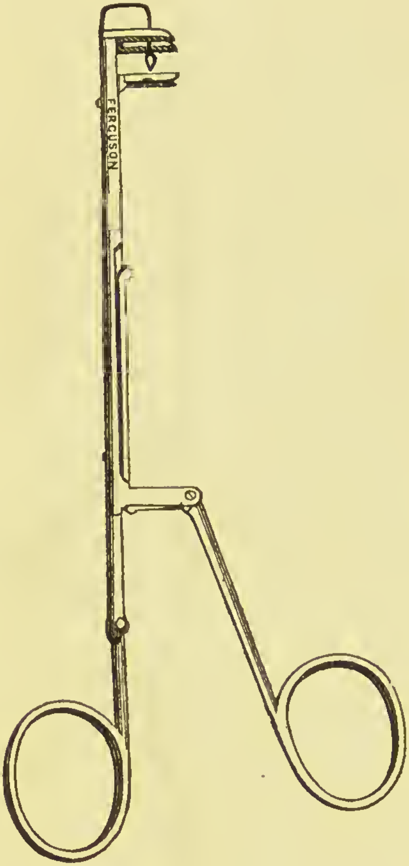
of minute and curved needles, the length of which should not exceed one-third of an inch, and they are held by means of the port aiguille. The threads employed should be of two sizes. About two of the larger size may be used towards the middle, at or about one-third the distance from each extremity of the incisions, the remainder may be finer, and occupy the centre and the extremities. The distance from the edge at which the needles are introduced, should be about that of a line, and the larger one something more, so that we have no fear of laceration in the act of drawing the sides together. It is better to commence above and terminate in the uvula, the opposite sides of which should be connected by one, or perhaps, when unusually long, by two ligatures.

Mr. Fergusson introduces the threads in a remarkably ingenious manner. By means of a curved needle fixed in a handle, distinct threads are separately passed through the flaps from before backwards. On one side it is doubled. Then the end of the single thread on the other side is passed through the loop in the end of the double one; and the latter being then withdrawn, the single thread is carried across from behind forwards through the opposite flap. He subsequently secures the threads by means of a running noose. But for a full account of all the ingenious details with which he has enriched this most interesting operation, I must refer to his work and papers on the subject.



In some difficult cases, the instrument which is here figured, and which is the invention of Mr. Ferguson, the instrument maker, may be found useful. The curved needle at the extremity can be thrust forward in the direction of the dotted line, by depressing the handle at the side. It is obvious, that, under certain circumstances, this may facilitate the introduction of the threads.

In other cases of difficulty, the operation may be facilitated by means of this instrument, which was contrived by my son, Mr. F. W. Skey, and manufactured by Mr. Ferguson. By its means the flap is seized, and the thread is at once passed through.



In this, as in truth in all operations, no instrument, however ingenious, can compensate for manual dexterity, and as a rule, the simpler the instruments that are employed, the better. Still, there are exceptional cases of extreme difficulty, in which, even the most skilful operator may, with advantage, avail himself of such an instrument as those just described.

In order to obviate the tension consequent on drawing into contact the two opposite sides of the cleft palate, it is necessary to resort to a valuable expedient, first generally adopted by Dieffenbach, of relaxing the tension by some form of lateral incision made on each side of the central line. These incisions may be made without reference to anatomy, and may involve the entire structure, whether muscles, cellular tissue, or mucous membrane, for all are equally in a state of tension.

Division of all the structures necessary.

When the sides are brought fully and exactly into contact, therefore, a sharp-pointed knife may be passed through the palate on each side, for the purpose of completely relaxing the tension on the wound, two longitudinal incisions being made of about three-quarters of an inch in length, and about half an inch from the mesial line. These wounds will bleed freely for a few minutes. The loss of blood will be much diminished by an occasional mouthful of iced water, and this is generally very grateful to the patient. During the operation, the surface must be repeatedly cleansed, and for this purpose three or four pieces of soft sponge or cotton wool, fixed to a piece of wood, should be used. The sponge, if soft, is preferable, and is frequently required to dislodge the coagulum and the tenacious saliva and mucus, incidental to long exposure of the cavity of the mouth to air, and the irritation. The patient is then placed in bed, usually a good deal exhausted. During the ensuing two days there is no necessity to debar him from food, which should consist of the strongest soup, with bread or maccaroni, milk with isinglass, wine in moderation, &c. Inflammation of the palate will almost inevitably follow to a moderate, but not to an injurious extent. In this condition of the surface, a solution of six or eight grains of nitrate of silver to the palate will be found useful in controlling the inflammation. It may be applied daily. By these means, and by the agency of full doses of tincture of bark, I have seen the entire wound unite by the second intention, as it is called, the process of union not having commenced till the use of the bark on the sixth day. The sutures should not be removed till they are palpably useless; in other words, until the union is complete and firm, or has entirely failed. I have generally removed them between the tenth and the eighteenth day. If they become a source of irritation, indicated by some increase of pain in swallowing, or by the presence of a red areola around the orifices of the threads, they should be cut out earlier. Should a first attempt partially or entirely fail, there is no objection, on any surgical grounds, to its repetition.

Lateral incisions.

Union by second intention.

Removal of sutures.

Such is an outline of the practice I have successfully adopted in a large number of cases. Mr. Fergusson, however, whose experience of the operation is doubtless larger than that of any other surgeon, advocates the division of the levator palati muscle only. This he accomplishes from behind, by means of a knife specially constructed for the purpose. This is the first step in his operation, and he ascertains, by touching them, that the flaps of the soft palate are quiescent, and hang passively before he pares their edges.

That the same end can be accomplished by this method I do not for one moment question; but I doubt whether it is effected by the complete and sole division of the levator palati muscle. I do not doubt that this muscle is the grand agent in separating the flaps; but I question whether it is the only one. Whether the incision is made in front or behind, the knife is applied until the palate is paralysed. In some cases it is even advisable to do more—to divide the pillars of the soft palate. I know that Mr. Gay attributes the success of many of his operations to this additional division. Again, when the hard palate is implicated, it may be advantageous to detach the lateral flaps of the soft palate to some extent from it, by means of a horizontal division. But while using the knife so extensively, it must be borne in mind that every application of it cuts off to a proportionate extent the supply of blood, and thus interferes with the union of the flaps. This important fact has been hitherto overlooked. May not some of the untoward results be dependent on this cause?

It has been attempted to close the fissure in the hard palate by an operation, and in some cases this has been actually accomplished. I have never made the attempt. The operation is by no means an inviting one, and the risk of failure very great. For further information concerning this operation, I gladly refer the reader to what Mr. Pollock has written on this subject in the Medico-Chirurgical Transactions, and elsewhere.

When the operation is finally completed, at the expiration of possibly three weeks or a month, the friends may begin to express disappointment that the articulation of the child, although improved, is still imperfect; and imperfect it will be for months and possibly for years, and not improbably for life. It is the duty of the surgeon to acknowledge this necessary evil before he undertakes the operation. A certain degree of improvement is inevitable, on mechanical grounds, but to represent to the parents of a child that the operation is a certain cure for its congenital defects, is to prove faithless to our trust as medical men, and to commit a breach of those acknowledged laws of honourable dealing, on the precise observance of which alone public confidence can be maintained. The operation, it must be confessed, is not a cure, and the whole that can be said in its favour is, that a cure is now possible, while before the operation it was impossible.

After management.

I feel it requisite, in the absence of any published directions on the subject, to say a few words on the after management of these cases. The treatment consists in regulating the actions of one series of muscles, and of exciting to action a second.

Functions of the tongue.

The first remark relates to the tongue. The tongue exercises two distinct functions, one relates to deglutition, the second to speech. These functions, when exercised in health, call on the organ for movements totally distinct from each other. In deglutition, as has been already explained, the tongue is engaged in pressing the food against the roof of the mouth and the soft palate, while speech requires its co-operation with the teeth and lips in the enunciation of sounds. There is an exception to this division in pronouncing the letters *d*, *h*, *l*, *n*, and *t*, and sometimes in sounding which, the tongue touches the roof for an instant, but rather incidentally than as essential to the required sound. In all persons having a defective palate, the movements of the tongue are eccentric, consequent on an instinctive effort to close the opening in the palate by its means, while endeavouring to fill up the interval of the fissure. This action becomes habitual, and is only subverted and corrected by the agency of time. The other series of muscles relate to those of the soft palate, which having been deprived of antagonism, and partially cut asunder during the operation, are weak and unsteady. The soft palate is paralysed, it does not respond to the actions either of the tongue or of the agents of respiration or of volition. Its condition corresponds, though in a minor degree, with that of the same organ in stertor, it vibrates under the influence of a current of air. The soft palate as well as the tongue must be educated.

Actions of soft palate in speech.

With respect to the tongue, I have seen great advantage obtained from speaking with a pebble in the mouth, or a glass bead, which has been fixed to the lower teeth, or some similar means of fixing it in the base of the mouth. In pronouncing the letters *c*, *s*, and *z*, the tongue is required to regulate the current of air passing through the closed teeth; but the organ is instinctively raised to its old position, and hence the difficulty of these letters. This difficulty is only to be overcome by long and continued exercise. In fact, the advantages derivable from the operation do not hold reference so much to the soft palate directly, as to the tongue, which by the union of the fissures is released from the abnormal duty of contributing to its closure.

Exercise of muscles of soft palate.

The muscles of the soft palate may be exercised without much difficulty in health. That we possess a voluntary command over them, may be inferred from the power exercised in regulating, by their means, the size of the column of air which passes at any given moment through the nose, as in the act of blowing it. In this action the soft palate is drawn backwards to touch the pharynx. Air is forced against it from below, and on the sudden remission of the contact is the force of the current obtained. Children who are the subjects of this deformity, should be taught to practise this and similar movements before a glass, with the mouth open. They should be required to read aloud frequently during each day, audibly and very slowly, and as distinctly as possible. I have generally recommended that the child should be placed at the distance of the further end of the room, and be required to speak in a loud tone, that all the defects of speech and difficulty of enunciation should be palpable to itself as well as to others. These difficulties will be chiefly comprised in the three letters I have mentioned, *c*, *s*, and *z*, and are really due to the tongue while holding a false relation to the front teeth, rather than to any want of action of the soft palate itself. This may be understood by observing the different characters of the sound in pronouncing the combination of the letters *sh*, as in the word *she*, and the sound of the *s* employed singly. In the former, which requires the approximation of the tongue to the roof of the mouth, children, after the operation, will pronounce almost perfectly; but directly the tongue is required in the front of the mouth

Defect of speech in the tongue.

to regulate the column of air passing through the teeth, then the defect becomes palpable, and the articulation imperfect. Perseverance in the endeavour to regulate these actions will succeed in enabling the patient to improve his speech in a very important degree, and to pass current in society without observation.

## BRONCHOCELE.

This disease does not frequently admit of relief through the medium of operative surgery. The enlargement of the thyroid body (or gland as it was formerly called) is so common a malady, and at the same time so little allied to what would bear the definition of disease, while the organ itself is, anatomically, so inseparably connected with the complicated structures around, that the practised operator is very reluctant to resort to the application of the knife for its relief. The question of extirpation of the thyroid body has been mooted, and actually proposed, in cases either of great and injurious enlargement, or of malignant disease. In either case, it is, in my opinion, barely admissible. If for enlargement, the condition of the so-called disease would never justify it, until the four arteries which supply the organ with the pabulum for its increase were cut off without benefit; and, even this, or rather these operations, are wisely eschewed by all reflecting surgeons, on the ground of their impracticability; and, *à fortiori*, the removal of the body itself must indeed be a difficult undertaking; while, if proposed for malignant disease, it is exceedingly improbable that such disease could be so entirely insulated by the knife as to justify the attempt to encounter so large an operation, and one which would be almost certain to be followed by a fatal result.

Extirpation inadmissible.

While on the subject of tying arteries in the region of the neck, I have referred to the operation for tying the superior thyroid artery, as performed by Sir W. Blizard, by Mr. Earle, and others. It is an operation, the performance of which is perfectly justifiable, and as I can testify, is attended with marked diminution of the enlarged structure, if this be the object to be attained; but the relations of the inferior thyroid are so much

Tying superior thyroid artery.

more complicated, and the artery itself lies so deeply embedded in the structures of the neck, that I conceive its exposure without danger to be almost impossible.

The removal of a portion of the thyroid body appears to me a proposition nearly as preposterous as that of its extirpation, and I can only counsel the young operator to avoid it.

Evil from pressure rare.

I am inclined to think that simple enlargement of the thyroid body is not so frequent a source of evil, on the ground of its pressure, as many suppose. I am quite aware that difficulty of respiration and of deglutition not very infrequently attend it, and that such symptoms appear to result from the presence of the abnormal structure, which occupies so large a portion of the anterior aspect of the neck; but I cannot forget that this condition of the organ is peculiarly incidental to young women; that the symptoms of inconvenience are very disproportioned to the size; that its attacks are eccentric and uncertain; and that the inconvenience of its presence is chiefly experienced during the catamenial periods. In fact, there is so much of hysteria mixed up with it, that I am myself exceedingly disinclined to countenance any attempt to afford relief by operation; and, assuredly, I have no faith in the proposition that was made, I believe, by Mr. Allan Burns, to divide the fascia covering it.

Often hysterical.

I have recently treated the following case of the above kind in St. Bartholomew's Hospital: A stout girl of eighteen suffered greatly from the presence of a large bronchocele. The isthmus was large and broad, and its pressure so great as to produce considerable difficulty in respiration, which was audible to persons at the opposite side of the ward, and her face greatly congested. So severe were these symptoms, that it appeared desirable to endeavour to afford her some relief by operation. Under the influence however of full doses of steel, the difficulty of breathing, with the very palpable reduction of the whole thyroid body, subsided, and her face recovered the natural tint of health.

Cells of thyroid body.

In cases of great enlargement of the thyroid body, a better, because a simpler, operation may be resorted to, which is equally efficient in affording relief and in avoiding danger. In some examples of enormous growth we find, by dissection, the mass to be composed of dilated cells containing serum, to the extent of from half an ounce to one ounce or more. These cells may be evacuated with a trocar, with great temporary relief. I have successfully adopted this principle of treatment in more than a single case. I saw, with Mr. Lobb, a lady who had one of the largest bronchoceles I have ever seen in England. All ordinary treatment failed to afford her relief from its most inconvenient weight. On examining it I ascertained the situation of various of the cysts of which it was composed. Into one of these I introduced a small hydrocele trocar, and removed seven drams of bloody serum. The wound healed. The fluid again collected, and the cyst was repunctured. We then attacked two or three of the others, and by repetition reduced permanently the bulk of the entire tumours; for, after repeated puncture, the cysts became reduced in size, and the relief was so great as to render the lady perfectly content with her condition.

Cases.

In another case I punctured a cyst of the thyroid body several years ago without danger or difficulty, but with great temporary benefit. In this instance I evacuated a considerably larger quantity of fluid than in the former case. I lost sight of the case, however, and am unable to give the result.

Mr. Arnott informs me that he has treated several cases in the Middlesex Hospital with success, and that in one patient he punctured a very large cyst of the thyroid body, from which he evacuated from five to six ounces of fluid.

Seton thread.

The application of a seton thread is so great a resource in many kinds of serous cysts, whether containing modifications of salivary fluid or albumen, whether in bursæ, ranula, or hydrocele, that one sees no reason why this remedy may not be employed with equal benefit in the cases in question. If a cyst be emptied with a trocar, and its size calculated by the quantity that escapes from it, there could be no difficulty in passing a thread into and through the cavity by means of a much-curved needle. The thread should be fine, as should the needle employed for its introduction, of substance, indeed, sufficient only to insure safety. The effect should be watched with care, and the thread removed on the occurrence of any positive pain.

Sternoid muscles.

In these enlargements of the thyroid body the sternoid muscles which cover it are so attenuated by the long-continued pressure, that a puncture through them is an unimportant consideration. The carotid arteries lie quite at the side and behind; and if those cysts only be selected for puncture that are clearly perceptible from the front surface, and the circle formed by the ligature be not greater than three-quarters of an inch, one does not see from what source evil could arise, so far as the operation itself is concerned.

## ON TRACHEOTOMY.

Surgeons are occasionally required to make an artificial opening into the windpipe, either with a view to obviate the fatal consequence of constriction of the canal, for the purpose of attempting the removal of a foreign body that has accidentally entered it, or for that of inflating the lungs in persons drowned. The extreme irritability of this canal, and its high degree of vitality, intimately connected as it is with the indispensability of its healthy functions to life, now disturbed either by disease or by the presence of a foreign body, renders this operation one of peculiar delicacy, and of some difficulty and danger. Tracheotomy is required in cases of disease of the larynx, the effect of which is to contract the canal. The seat of such disease is, of course, the glottis, around the orifice of which the membrane is thickened by inflammation, and its products, such as the deposition of lymph, which presents itself in the form of an adventitious membrane. The contraction of the canal thus formed, however, bears no comparison to the difficulty caused in the respiratory function, which is affected in a degree apparently disproportioned to the encroachment on the tube, thus indicating the value of this structure in the economy of the living body, and on this principle we explain the irregular and spasmodic nature of the symptoms which characterize its diseases.

Deposition of lymph.

Diseases

The disease for which the operation is required, is, most commonly, laryngitis, attended by thickening of the membrane covering the chordæ vocales, whether affected primarily or by extension from the fauces or tonsils. In determining the necessity of the operation, we do not pretend to be governed by the presence of this or that form of disease, but by the pressure of symptoms, which, if imminent, demand artificial opening, to whatever class they belong, or in whatever region they originate. In order to justify the operation, the symptoms must be clearly defined, and the case thoroughly understood by the surgeon. These symptoms are, great dyspnœa, threatening suffocation, loss of voice, the act of inspiration short, and made with a painful effort, and often productive of a whistling sound in the larynx; lividity of the skin, either of the face or extremities; respiratory murmur imperfectly heard over the surface of each lung. The symptoms may be distinguished from those of fluid in the pleural cavity, by the disease being obviously referable to a point common to the two sides of the chest. The lungs equally participate in the difficulty consequent on an obstruction common to the two. There is no evidence of disease referred to the chest, but there *is* evidence of that of the larynx or trachea, indicated by local pain, with more or less of swelling and tenderness on pressure. In laryngitis the patient is raised in bed with his head drawn forwards, while in empyema the body is often inclined over to the diseased side. In cases of more than usual difficulty the most careful diagnosis is required; for it cannot be denied that the best authority obtainable in several examples has been led into error.

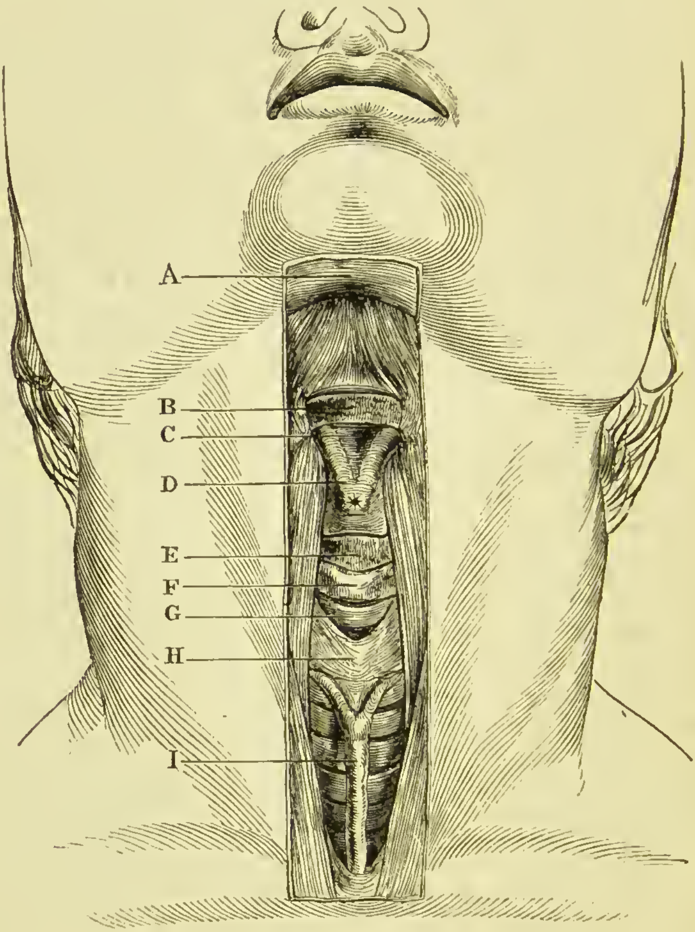
requiring tracheotomy.

With such symptoms, and with threatening suffocation, the surgeon has no alternative but that of operation; but before proceeding to this crisis, he should survey the neck, and call to his recollection the relations of the various structures occupying its central line, and proceed to select that situation in which the opening may be made with the least danger. This selection is a very important consideration. In order to assist in this decision, I have made the following sketch of the middle line of the neck.

Symptoms justifying operation.

Any incision made into the air-tube above, or through the cricoid cartilage, would constitute the operation of laryngotomy. Now the distance between the point of connection of the chordæ vocales, and the crico-thyroid membrane, which is the only membranous part through which an opening can be made below the cords, is not more than one-third of an inch; and supposing the disease to be, as usually found, occupying the glottis or the opening between the cords, it is not unreasonable to suppose that inflammation and thickening will advance even lower than the point indicated, and that the consequences

Extent of disease.



A. Base of the jaw.
B. Os hyoides.
C. Thyro-hyoid ligament.
D. Thyroid cartilage.
E. Crico-thyroid ligament.
F. Cricoid cartilage.
G. First ring of trachea.
H. Isthmus of thyroid body.
I. Inferior thyroid vein.

* Insertion of epiglottis, and immediately below is the attachment of chordæ vocales.

of the operation may extend to them from the close proximity of the opening made into the tube and the cords above. In order to avoid this evil, the part selected has usually been that below the isthmus of the thyroid body; but to this locality there are abundant objections. In the first place the trachea is placed very deeply in the neck, increasing as it descends. Immediately above the sternum, the air-tube lies at a distance of more than one inch from the surface, and this is a great depth to dissect upon in so critical a region, even under the guarantee of the soundest anatomical knowledge. Another difficulty is founded on the very great irregularity of the vessels in this region descending on the trachea. It must be recollected, that the two sterno-thyroid muscles are placed side by side, and closely in contact, and that although it may not be difficult to hit the precise line of junction in the dead subject, it is often difficult to effect it in the living, and having once lost the mesial line, all is uncertainty onwards in the dissection. The vessels underneath the sterno-thyroid consist of a large venous trunk of great size, the inferior thyroid, or a congeries of smaller veins, which from their proximity to the heart bleed very freely, and fill the wound with blood. This wound it is, perhaps, more indispensable to the progress of the operation to be kept dry and clean, than any wound made in operative surgery; for the blood, trickling into the trachea when opened, would aggravate the patient's suffering, and, if profuse, would probably prove fatal. Besides these vessels, we have occasionally a middle thyroid artery, ascending on the trachea from the arch of the aorta. These obstacles to the progress of the operation render it tedious, and often dangerous; and I have known the operation to be entirely arrested, under the hand of a surgeon of some experience, in consequence of the number and size of the veins usually occupying the front of the tube. Indeed, it is very rare that they are entirely absent. The exposure of the surface of the trachea above the thyroid isthmus has not those objections. It will be observed, that a space is there left uncovered by muscle or gland, of about a quarter of an inch in length. This part of the air-tube is nearer to the surface, and though not destitute of vessels, is comparatively free from them. An artery of some size, often, though not generally, coasts

Depth of trachea.

Irregularity of vessels.

Always a difficult operation.

Operation above thyroid isthmus.

along and in contact with the upper border of the isthmus, crossing the trachea. This is the point that should be selected for the operation of tracheotomy. It is true that its size is limited, scarcely admitting the passage of the curved trocar; but to obviate this disadvantage, the isthmus being connected to the trachea by cellular tissue only, may be detached by a blunt hook, and drawn forcibly downwards; indeed, if necessary, and in the absence of the transverse inosculating branch of the superior thyroid arteries, the isthmus may be divided along the mesial line, and without bleeding, consequent on the limited number of the inosculating branches of the two lobes. I have been troubled, even in this situation, by the presence of veins; but, if present, they are small in comparison with the venous trunks covering the trachea below the isthmus. Every difficulty in the progress of the operation for tracheotomy, when called for by disease, should be avoided, on account of the inconvenient and irksome position of the surgeon, caused by that of the patient, who resists every attempt to place his head in a favourable attitude for the purpose, with the instinctive object of preventing strangulation.

Difficulty of position.

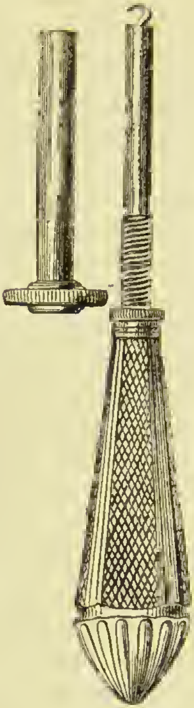
This situation should be selected, also, whenever it is deemed necessary to perform the operation of tracheotomy, for the purpose of inflating the lungs in drowned persons; but, on other occasions, and in the absence of disease, there is no objection to the higher operation, or that of laryngotomy. When an opening is made for the purpose of facilitating the removal of foreign bodies by the introduction of an instrument through the opening, the lower operation, or that above the sternum, may promise a better chance of success; but as I have never known any advantage to arise from such introduction, but rather an aggravation of the patient's sufferings, so the operation, when performed with this view, does not appear to me to justify a deviation from the recommendation above given.

Operation.

Previous to the operation, the surgeon should make a careful examination of the mesial line of the neck, and mark the point of the canal which he proposes to open. The patient is then placed in such a position in bed as will afford the operator a perfect command of the neck, so far as this is compatible with the respiration of the patient. But this function being deranged, the best position, viz., that of the head thrown sufficiently backwards, is rendered very painful, and is often impossible to be retained for any length of time. Between the necessities of the patient and the requirements of the surgeon, the best compromise must be made. An incision of about an inch and a half in length is made in the mesial line, beginning about the middle of the thyroid cartilage, and continued downwards, and the parts carefully dissected till the cricoid cartilage is exposed. The examination of the trachea below should be made with more caution; and the parts being exposed, the operator will be enabled to judge whether he has space sufficient to introduce the tube above the isthmus. If not, this part of the thyroid body may be drawn downwards with a blunt hook. Space being thus obtained, a fine knife should be passed into the trachea, and a circular piece cut out, great care being taken to hold it firm while cutting. This purpose will be best attained by the trachea being held firmly by means of a small pointed hook, to which a strong wooden handle is fixed. The relief to the respiration will be instantaneous. The curved chain trocar, which was invented by the late Mr. John Wood, is occasionally employed. I have used it on more than one occasion; but the objection to it is founded on the difficulty of its first introduction; and, although the presence of a canula in the wound answers two important indications,—first, of preventing the entrance of blood into the tube, and, secondly, that it fully retains the opening,—yet I am inclined to think, that when we have no hæmorrhage to contend against, and the disease, being of recent existence, leads to the probability of early recovery, it is better to divest the trachea of the foreign body altogether, and to rely on the removal of a circular portion of the tube. The introduction, and even the presence of the canula, is generally a source of great irritation and coughing, much of which may be avoided by leaving the opening unmolested. The accompanying sketch represents an ingenious instrument which I think superior in principle either to the knife or to the chain trocar. It consists of a canula with a cutting edge, through which passes a trocar cylinder, terminating not in a cutting point, but in a small hook. The two are connected by a well-

Chain trocar.

made screw, by which the canula revolves upon the trocar within it. The screw-point projects a quarter of an inch beyond the cutting edge of the canula. The instrument is applied by seizing the portion of the trachea to be removed with the hook; the canula is then screwed down, with its cutting-edge on the rings of the tube, and the centre-piece drawn out. The canula may be retained or not. This instrument, which is the invention of Dr. Marshall Hall, labours under the great objection of difficulty of application to the moveable surface on which it has to act.



Great after attention is required by the patient. The attendants should be instructed in the best mode of keeping the wound clear of mucus, which tends frequently to obstruct the current of air through it.

Tempera-ture of room.

The most important part of the after treatment is too often altogether ignored. One frequent cause of death after tracheotomy is pneumonia, induced no doubt, by the direct passage of cold air into the lungs. The just dread of this occurrence often makes physicians hesitate to sanction the operation, even when it is somewhat urgently demanded. The remedy for this, and for similar sources of danger, is to place the patient during and after the operation in an atmosphere artificially warmed and moistened. Its temperature should be raised to, and kept steadily at 80° or 85°, and a copious supply of steam thrown into the room. This latter point is easily effected by prolonging the spout of an ordinary kettle. It is an additional precaution to cover the orifice of the canula with a piece of gauze, to sift the air. These simple precautions should never be neglected. A patient, who after the operation is left in an ordinary atmosphere, exposed to constant changes of its temperature, is in many instances deprived of his best, perhaps his only chance of recovery.

Size of tube.

One other caution should be mentioned. For some hours after the operation, the patient, more especially if he be a child, should be carefully watched to ascertain that the blood is sufficiently aerated. It is a fact which should never be forgotten, that a tube through which a person may breathe with comparative comfort for a few minutes may nevertheless be too small for a permanent supply and interchange of air. Of this any one may convince himself by breathing for a short time through a piece of ordinary tobacco pipe. The difficulty will not be apparent until after the lapse of a short interval. Therefore, when from any circumstance we have been compelled to use a small tube, we should jealously watch our patient for the signs of recurring asphixia. If we are alive to the cause, the remedy is obvious.

Operation below isthmus.

The lower operation, performed in the supra-sternal fossa, requires the lower and more lengthened incision, and the greatest care is required in dissecting the surface of the trachea. The depth of the wound will prolong the operation to double the length of time required for the other. In this and in all similar conditions silver knives will be found most valuable, simply because they may be employed freely, with less danger of hæmorrhage than applies to a sharp-edged instrument. There is no true heroism in wilful danger. Mr. Syme rejects the blunt-edged knife. Sir B. Brodie and many other high authorities adopt it on special occasions.

*Laryngotomy.*—In opening the larynx the crico-thyroid ligament is divided. The external incision should be commenced at the highest part of the thyroid cartilage, and continued down along the mesial line, and the dissection carried on to the ligament.

When clearly exposed, the crico-thyroid ligament should be cut away entirely, in order to allow of space sufficient for respiration. The interval between the thyroid and cricoid cartilages is so narrow, as to require their being rendered as clean as possible. As in the previous operation, it is preferable, having made the orifice into the air-tube as patent as possible, to leave it without an instrument.

# CHAPTER XXI.

## OPERATIONS ON THE CHEST AND ABDOMEN.

*Paracentesis Thoracis.*—The cavity of the pleura, consequent on an attack of pleurisy, may become distended with fluid, which may exercise a very injurious degree of pressure on the body of the lung, and materially influence the position of the heart. Under these circumstances, a surgeon is occasionally called on to relieve the patient by evacuating the fluid. As the discredit of failure would be equally shared by the adviser and the performer, it is the duty of the surgeon to ascertain for himself the necessity of the operation before he undertakes it.

Responsibility of operator.

The operation is justified, supposing the physical signs of fluid in the pleura to be unequivocal, either by the urgent symptoms actually present, as severe dyspnœa threatening suffocation, or by the failure of all other means to produce absorption, for the most serious consequences may result from the prolonged presence of much fluid in the pleura. The heart and other viscera are displaced, and therefore embarrassed in their functions, and the lung, if too long compressed against the spine, may be permanently bound there, and so rendered for the future comparatively useless.

I say in every case the physical signs of a large amount of fluid in the pleura should be unequivocal, at all events at the spot where the puncture is contemplated. Absolute dulness, the entire absence of all breath and voice sounds (except such as may be occasionally indirectly transmitted), and the cessation of all vocal vibration. If in addition to these there is enlargement of the affected side, and abnormal fulness of the corresponding intercostal spaces, the evidence is still more satisfactory.

It is always desirable to distinguish empyema from hydrothorax. In purulent formation we have usually rigours and hectic fever, and generally more constitutional disturbance, than in the more chronic form of disease. We cannot hope for the absorption of the pus of empyema, which is only to be got rid of by puncture, whereas the whey-like fluid or serum of hydrothorax is frequently absorbed under appropriate treatment; therefore the operation of paracentesis is more directly indicated in the one disease than in the other.

Part to be punctured.

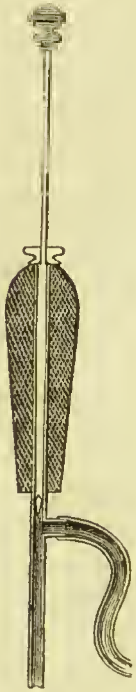
The objection to a puncture forwards towards the sternum, is found in the gravitation of the fluid backwards in the position in which patients usually lie. The objection to that backwards, towards the spine, consists in the narrowness of the intercostal spaces, the larger size of the intercostal arteries, and the greater thickness of the muscular investment of the chest. One rule, however, is yet more important, viz., to select a point towards the centre of the fluid collected; and inasmuch as the objection on the ground of gravitation may be met by a corresponding position of the patient, so it is better to err by puncture in the direction forwards than backwards, unless, indeed, it is intended to retain the opening by the presence of a hollow tube in the wound.

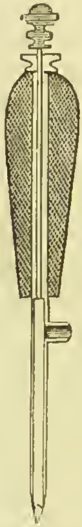
Previous incision unnecessary.

The instrument used should be a flat trocar, of a size intermediate between those employed in hydrocele and ascites. There is no necessity for the previous introduction of a grooved needle. The trocar should be introduced, without previous incision by the knife, in the centre between the ribs, by drawing aside the skin, and making a valvular opening as low down in the chest as possible; but whether between the fifth and sixth, or between the sixth and seventh, or still lower, does not, so far as I know, admit of any imperative rule; unless, indeed, when in empyema the matter points on the surface, I believe it would be equally safe between the ninth and tenth, if the puncture be made far backwards. The trunk of the intercostal artery runs along the lower edge of the upper, and a considerable branch along the upper edge of the rib below. When the fluid is nearly evacuated, or at least when it ceases to flow spontaneously, except by requiring an occasional effort at full inspiration, the canula may be withdrawn, and the wound healed. It is of great importance to prevent the ingress of air into the cavity during the operation, and for this purpose a useful instrument has been invented, by which the fluid is drawn off under water, and thus the liability to this evil is entirely prevented. It is better to repeat the puncture when necessary, than to retain a gum catheter in the wound, which practice I have on some occasions adopted.

Mr. Thompson's trocar.

The accompanying figures represent a very ingenious instrument invented by Mr. C. R. Thompson, of Westerham, which is admirably adapted for puncture of the chest without allowing the ingress of any air. Unfortunately from want of opportunity it has not, to my knowledge, been yet tried upon the living subject, but it is not difficult to predict its complete success. It consists, as is seen, of a canula, in the side of which is an aperture; to this a vulcanised rubber tube is adapted, the other extremity being placed under water. The instrument is so constructed as to permit the shaft of the trocar (which is so accurately fitted to the canula as to be air-tight) to be withdrawn only to the extent of allowing the point to pass immediately behind the lateral aperture. The second figure represents the instrument before it is introduced, the first with the elastic tube attached, and the shaft withdrawn for the contents to escape.





Expansion of lung.

As to the quantity or proportion of the fluid to be evacuated, it would certainly appear on all accounts desirable that a portion only be removed at a time, allowing an interval for the lung to expand; for, as Dr. Williams observes, something must occupy the space of the fluid removed, and it is not probable that the lung is always in a condition to expand sufficiently to fill it. Moreover, in the case of hydrothorax, by the removal of a portion of the containing fluid we place the remaining quantity in a better condition for absorption. Dr. Williams has suggested the propriety of injecting warm boiled water into the cavity, to displace and dilute the pus in case of necessity, and would even justify medicated injections.

Medicated injections.

A curious case occurred in St. Bartholomew's Hospital, in which, with well-marked symptoms, Mr. Stanley twice failed to obtain fluid after puncture. On examination, it appeared that the cause of the difficulty arose from the presence of a small membrane that was on each occasion pushed before the trocar.

To the above I may add some of the physical signs of pneumothorax, which consists in peculiar resonance on percussion, with metallic tinkling when accompanied with fluid, loss of voice and breath sound, or amphoric resonance of voice if the layer of air be not very thick, and limited movements of respiration. There is usually more or less fluid in the cavity, the line of which may be ascertained by percussion. It is better to tap, so as to evacuate the fluid and air at the same time. Much benefit is derived from rolling the chest tolerably tightly, both during and after the operation, with an elastic bandage, as in the case of the same operation on the abdomen, and more especially when the collection of fluid has been large and the ribs distended.

## OPERATION ON THE ABDOMINAL PARIETES.

*Paracentesis Abdominis.*—This operation is required for the removal of fluid, collected either in the peritoneum or in the ovary, constituting either ascites or ovarian dropsy. In operating for ovarian dropsy, it is always desirable to ascertain by percussion, &c., the degree of density of the contained fluid. The degree of fluidity of the contents of the sac may be ascertained with some exactness by percussion. If consisting of pure serum, the *slightest* concussion of the finger is perceptible on the opposite side of the abdomen. By careful percussion we glean some knowledge of the number and general size of the cysts, supposing several to exist.

Ovarian dropsy.

Trocar.

The size of the trocar should be moderate. There is no advantage to be derived from the employment of a very large instrument. A hydrocele trocar will often suffice; and in some cases it is even advantageous to employ the finest instrument, allowing the fluid to drain off gradually. Previous to the operation, an elastic belt, perforated in front by a hole, should be fixed round the abdomen, and attached by buckles behind, so that it may be tightened during the operation, if requisite. The trocar may be introduced from one to three inches below the umbilicus, and if done rapidly, is almost a painless operation.

This operation is rarely undertaken, except for the purpose of affording temporary relief. In ovarian disease, supposing the cyst to be multilocular, and the evacuation of the cyst first punctured fail to afford relief, a second or a third puncture may be made through any part of the front wall of the abdomen, avoiding as much as possible the neighbourhood of the epigastric arteries.

Ascites.

The proportion of the fluid to be evacuated, whether in ascites or in ovarian disease, is a question of much interest to the surgeon. It has been proposed to evacuate the contents of the cyst in either disease, by repeated evacuations of a portion of the fluid only, and this modification is occasionally attended by the best results. Sufficient fluid may be removed to obtain temporary relief to the respiration and to the general symptoms of oppression, and the operation repeated in the course of a few days, and again at the same interval. It is also desirable to try largely the experiment of acupuncture, that somewhat mysterious agent of good that exercises an important influences in many diseases. With the effects of acupuncture in hydrocele, all are familiar; and I am satisfied we shall not employ it uselessly, in the larger diseases of ascites or ovarian dropsy.

In reference to the question of selection of the locality for puncture, I cannot help referring to a case of ascites on which I operated two years since. The contents of the abdominal sac communicated with the cavity of the tunica vaginalis belonging to the right testicle, from which they were readily evacuated by puncture. With the concurrence of Dr. Lobb I removed the entire fluid from the abdomen, by means of a puncture made at the bottom of the scrotum with a hydrocele trocar.

Abdominal abscess.

*Abscess in the Parietes of the Abdomen.*—Abscess in the subcutaneous tissue and fat of the abdominal wall, though not common, is more frequently met with than the same disease occurring between the muscles, or than that of abscess in the sheath of the rectus muscle, which is an exceedingly rare disease. When situated over or in the neighbourhood of the liver, it is often mistaken for abscess in the organ itself.

In my College Lectures published in the Medical Times and Gazette, 1853 and 1854, I have given an account of these chronic abdominal abscesses, several of which have come under my observation during the last few years. They appear most commonly situated at the side and lower part of the abdomen, and to present themselves in the form of a thick firm mass of greater or less size, but commonly of several inches in diameter. They do not project, and therefore are not detectable by the eye till a late period of their progress, when they slowly approach the surface. If they can be made to point, by means of forcing up the constitutional powers to the level of active suppuration, they will present forwards at the distance of from three to five inches from the crista of the ilium; but if this effort fail, the abscess will extend downwards along the track of the femoral vessels, where the fluctuation communicating with the matter above will be very perceptible. Within the last six months two examples of this disease have been under my care. In both of them the malady was ushered in with symptoms of sciatica. One of them, a male patient in St. Bartholomew's Hospital, I treated for sciatica for a fortnight, when I detected the thickening in front of the abdomen. The somewhat hard swelling became very large, extended upwards towards the ribs, and down the track of the femoral vessels, but I could not succeed in bringing it to the surface. For a time the disease appeared stationary, and then the swelling became very palpably reduced in size. On examining his gluteal region, it was obvious that the sac had given way, and the contents had escaped backwards through the sacro-iliac foramen; but the change was unattended by pain or constitutional disturbance. In the course of a few days, the gluteal region and thigh became greatly swollen and the fluctuation palpable over the entire of this region. I evacuated the contents by an incision that divided the gluteus maximus muscle. Between two and three pints of matter escaped. The man recovered.

In the other case, that of a lady, the matter extended along the sheath of the vessels, but failed to point forwards. She complained of pain extending backwards towards the lumbar vertebræ, but I saw no evidence leading to the supposition of disease of bone. I watched the case of this lady with interest for many months, till it became obvious that some local effort must be made to bring the disease to a crisis, as she now suffered much from the enlargement or the distension of the sac.

Mr. Arnott visited her with me, and concurred in the necessity of puncturing the abscess with a small trocar, by the use of which I gave her on two occasions some considerable relief. But the abscess increased, and it became necessary to make a free opening, to which I had not earlier resorted, in consequence of the delicate state of the lady's health. I evacuated the healthy contents of a large sac, by an incision carefully made about an inch from the crista ilii, and three inches above the anterior spine. The lady died.

In another case, the subject of the disease, a gentleman, strenuously declined the operation, until he sent for me after an absence of some weeks. I found the abscess had extended from the left ilium, and presenting a tumour, occupying nearly one-third of the entire cavity of the abdomen. With the co-operation and assistance of Mr. Savory, I divided the layers constituting the abdominal parietes, about one inch from the crista ilii. On separating the fibres of the transversalis muscle an immense quantity of most fœtid matter escaped, which rendered the atmosphere of the room offensive for many days to all who did not occupy it. He died about a week after the operation.

Generally speaking, these abscesses do not present the formidable characters which attach to those I have alluded to. They commonly indicate a greater tendency to point towards the skin of the abdomen. But under most conditions it would appear desirable to puncture early.

If the abscess be not very large, this operation may be performed with a trocar or a common abscess lancet, the patient being laid over pillows or a sofa cushion, with a view to render the abdomen as prominent as possible. A piece of lint may be introduced into the wound.

Abscess in the walls.

Abscess of the walls of the abdomen in the region of the liver, may be distinguished from abscess of the liver itself by having more thickening around it, the cellular thickening of the wall itself, by the absence of much constitutional irritation, always present in this description of disease of the liver. The nucleus of the diseased action generally appears, as it really is, near the surface, and the skin exhibits a larger areola of redness as the disease is matured. Besides which, on examination, it will be seen that the abscess does not occupy the true locality for hepatic disease. A young medical student was under my care with abscess below the margin of the ribs, on the right side. His father was a medical man, and by whom he was sent up to town to be treated for hepatic abscess. He had also, at the same time, a positive attack of jaundice. Notwithstanding the jaundice, I felt satisfied the abscess was not connected with the liver, and I punctured it, and he recovered. In all such abscesses, if slow in advancing, bark in considerable doses may be given with advantage.

## PELVIC ABSCESS.

Collections of matter not unfrequently form beneath the peritoneal coat of the pelvic organs, both in the male and female, but more especially in the latter sex. In the male they occasionally occupy the tissue which separates the bladder from the rectum, below the recto-vesical serous membrane. In the female they are more common, more extensive, and more serious in their character, and there are few accoucheurs of large experience who are not more or less familiar with the nature and progress of a pelvic abscess.

Pelvic abscess may occur independently of parturition, or during its progress, when it always assumes a more grave character. It is ushered in with local pain and rigors, and general symptoms of gradually impaired health being often very chronic in its progress. As the disease advances, the attention of the medical attendant is directed to the affected region, and an examination, whether per vaginam or per anum, will be observed to cause more pain than is usual in the healthy condition of these parts. A degree of tenderness on pressure by the finger, is palpable at one or the other side of the vagina, from which the matter may extend throughout the sub-peritoneal cellular tissue of the uterus or bladder, and advance downwards by the side of the rectum as far as the sphincter.

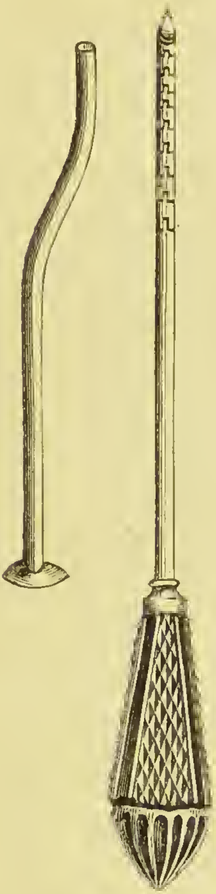
If the progress of the abscess be such as to bring it within the limits of an acute character, if instead of occupying a period of months it reach its crisis in a shorter period, the abscess may burst into the vagina, the rectum, or even the bladder, the latter being evidenced by a large escape of matter mixed with the urine, and by the sudden subsidence of all the symptoms. Here the active, or at least the progressive stage of the disease ceases, and with it its usual concomitants of fever and local pain. When the abscess bursts into the bladder we may reasonably suppose that the opening through the walls of the organ is sufficiently valvular to preclude the escape of urine from the cavity, because no such symptoms occur as appear on the extravasation of urine elsewhere. It is remarkable in some cases how discursive and errant is the progress of the purulent formation. Suppurative action beginning in the cellular tissue, between the uterus and rectum, may extend in any and in all directions. I saw a lady in the country who had suffered from acute *cellulitis* as it is termed in this region, and the abscess burst into the rectum, and relief followed for many weeks. The diseased action then extended, and matter travelled upwards around the uterus and around the bladder, up the linea alba, and eventually the abscess burst at the umbilicus. When the abscess points either in the vagina or the rectum, it is perceptible by the finger pressing upon it. In either case the relief by puncture should be resorted to, provided the symptoms—generally obvious enough—of pent-up matter are present. If the local symptoms are not urgent, the disease may be left to Nature to accomplish the work in her own way; but it rarely happens that we are not compelled to resort to the immediate relief afforded by giving outlet to the contents of the abscess.

In some rarer forms of pelvis abscess the progress of the affection is attended by very severe and protracted pain, extending from the interior of the pelvic cavity downwards along the groin and inner side of the thigh, and backwards along the track of the sciatic nerve. In these cases it is highly probable that the disease is seated under and external to the pelvic fascia, and in contact with the wall of the pelvis. The progress towards maturity is very protracted, and the sufferings of the patient most distressing.

In one very anxious case which I attended in conjunction with Sir Charles Locock and Dr. Protheroe Smith, the presence of abscess was detected by these gentlemen three weeks prior to the consummation of the disease; but the sensation conveyed to the finger was peculiar, inasmuch as instead of a full and globular swelling projecting inwards, the sensation was that of a thin layer of elastic fluid placed close to the surface of the bone. The matter at length protruded itself inwards, and I punctured the abscess from the rectum, and evacuated the sac to the extent of eleven ounces of healthy pus. Under ordinary circumstances it is preferable to puncture from the rectum rather than from the vagina, though the question will perhaps be determined by the relation of the projecting sac to the one or the other canal. In the case I have above alluded to the circumstance of an advanced pregnancy left me no alternative.

For the operation of puncture of pelvic abscess a common trocar is objectionable, because, unless the protrusion is great, the difficulty is increased by the necessary obliquity of the instrument to the canal, whether the vagina or the rectum be selected. I prefer a double-curved instrument, the extremity of which can be brought into its proper relation to the mucous surface covering the cyst of the abscess, without the shaft being distorted from the straight line formed between the orifice and the canal within. The size is that intermediate between the ascites and the hydrocele trocar, and should be flat instead of round in shape. In order to accomplish the introduction of the trocar into the canula, the shaft of the trocar should be freely pointed, and two canulas of different curves will be found useful. When the contents are evacuated, the canula may be withdrawn, and we have no grounds for apprehending any escape of fœcal matter from the rectum into the sac of the abscess, because the opening being made from before backwards, the orifice is necessarily valvular.

In some cases I have found the instrument which is here figured very useful for reaching a collection of pus. The canula has a double curve, and the shaft is jointed towards the point, so as to pass through the canula without difficulty.



The case in question was one of unusual severity. Having punctured the sac of the abscess from the rectum, and evacuated so large a quantity of matter, we indulged the hope, not an unreasonable one, of great and permanent relief. But the benefit was small, and of short duration. Pains recurred within twenty-four hours, of a more severe character than before, which opiates in enormous doses failed to mitigate. The pulse which, after the puncture, had fallen to 80, again rose to 130. The pain was now more especially referred to the gluteal region, and along the track of the sciatic nerve; but in consequence of the limb being drawn forwards and fixed in this, as the only bearable position, no fluctuation could be detected. During the ensuing week the pains were paroxysmal, but not ascertainably periodic. She had the occasional relief of six or eight hours, and then they recurred with increased violence. During the whole of this time the inner part of the abscess continued to discharge somewhat freely by the rectum. On the 12th day I felt satisfied I detected deep-seated matter over the dorsum ilii. The physicians in attendance arrived at the same conclusion, and I made an incision through the most projecting part of the integuments. I then punctured the muscles with a grooved needle, pus flowed, and I laid the wound open freely to the bone, and got away about fourteen ounces of fœtid pus.

# CHAPTER XXII.

## ON HERNIA.

OPERATING THEATRE THE BEST SCHOOL—DEFINITION—CAUSES—SYMPTOMS—ANATOMY OF INGUINAL HERNIA—ANATOMY OF DIRECT HERNIA—OPERATION—QUESTION OF DIVISION OF SAC—AFTER-TREATMENT—INFLAMMATION, TRUE AND FALSE—FEMORAL HERNIA—OPERATION—UMBILICAL HERNIA—OPERATION.

Experience the only school for hernia.

The operating theatre of a hospital is the only school for the acquisition of a complete and practical knowledge of hernia. Indispensable as may be the cultivation of anatomy, to entitle a surgeon to rank in the operative department of our art, we find, perhaps, no branch of the subject in which the acquirement of the dissecting-room leaves the real necessities of the practical surgeon so unsatisfied as that of hernia, or in which the recollections or associations of that theatre of study can so little be brought to bear upon the almost infinite varieties of form and structure, that present themselves to the operator throughout a long career of hospital practice.

And yet, without the education of the dissecting-room, without the possession of the knowledge which practical manipulation alone can give us, who will venture to operate for hernia? If the science of anatomy does not reach the actual level of our wants, and in reference to the subject of hernia it never can, we must not forget that to this study we are indebted for that knowledge, which alone can form a safe and efficient foundation for the subsequent acquisition of practical experience.

Anatomy indispensable, but insufficient.

I do not, by such remarks, desire to depreciate the value of anatomical knowledge in reference to the subject before us, but merely to express my conviction, that no man is less competent to the exigencies of the operating table, when called upon to dissect down to the seat of stricture in a case of strangulated hernia, than he whose functions have been restricted to the duties of the dissecting-room.

If we divide an operation for strangulated hernia into three distinct stages, and give to the first of these, the dissection requisite to expose the seat of stricture; to the second, the division of the stricture itself; and to the third, the replacement of the intestine, or other part protruded, it must be acknowledged that we owe to anatomy nearly all the information by which we are enabled to remove the greatest difficulty in our path, with safety to our patient.

In reference to the subject of hernia, it is necessary to distinguish between a knowledge of *the parts in which hernia occurs,* and that of *the same parts affected with hernia,* than which no two regions can be more dissimilar. And yet they have characters and relations in common. It is just this common property of the two conditions, which is valuable to the surgeon, and without a familiarity with which, the operation for strangulated hernia has always more or less of danger attached to it. For example, no hernia, however large, can alter the relations of the epigastric artery to the internal ring, in inguinal hernia, or that of Gimbernat's ligament, or the femoral vein, to femoral hernia. These are salient points, from which we start; permanent beacons, for our guidance in all examples of inguinal or femoral hernia. But, on the other hand, when we are told by the anatomist that in its descent from the interior of the abdomen into the scrotum, the spermatic cord receives certain coverings or investments from the layers constituting the abdominal parietes, and that each of these investments may be known by certain definite characters, we shall look in vain for their realization, either in quality or in number, because the structures have undergone so complete a change of texture, that no one can be identified as bearing out the description of the anatomist. To a certain point, therefore, we must rely on anatomical knowledge; beyond this, it will only lead us into danger.

Alteration of structure in hernia.

Before I proceed to describe the various operations required for the relief of strangulated hernia, I propose to make some preliminary remarks on the nature and cause of the protusion which has received this name.

Remote causes.

The greater liability to abdominal than thoracic hernia is due to two causes:—First, because the quantity of the contents of the abdomen varies at different periods, not only of life, but of each day; a different relation exists between these contents and the containing walls, and these relations are subject to pressure, both forcible and spasmodic, from the muscular structure of the walls acting on four, out of six surfaces, at the same time. Second, because the integrity of the walls is rendered imperfect, by the necessary transmission through them of certain vessels, and other structures required for the supply of the economy beyond. These two conditions operate as the most remote of the causes to which hernia may be attributed, and are incidental to the natural structure.

Firm pressure is made on the moveable contents of the cavity in all muscular efforts of the body, by the conjoint and harmonious antagonism of the diaphragm and abdominal muscles, forming its upper and anterior lateral boundaries. Either the excess or the too sudden operation of this pressure protrudes a portion of the contents through the inguinal or femoral rings, or at any other defective point of the walls, and the hernia is formed. But this protrusion is readily returned, and again descends on the recurrence even of a lesser cause. If, however, on the occurrence of any exertion requiring especial force of contraction of the abdominal muscles, a larger portion of intestine than usual is forced from the cavity, the hitherto successful efforts at its restoration fail. This difficulty is not referable to the increased contraction of the opening, through which the intestine has passed, but on the increased quantity of the substance passing, and this increased quantity exercises a greater than ordinary pressure on the surface of the ring. The consequence of such pressure is retention of blood in the protruded parts, the venous system being obstructed, and the whole protrusion increases in size. *A hernia is always the cause of its own trangulation,* unless the aperture by which it escapes from the abdomen, consists of muscular fibres so arranged as to be able to contract around it. In the case of diaphragmatic or in some forms of ventral hernia, these wo causes operate conjointly, but in all ordinary forms of this disease the ring is passive and not active in its relation to the proximate cause, and neither in the inguinal, femoral, or umbilical forms of hernia do we find muscular action otherwise than very remotely concerned in the causes of strangulation. In the disease known under the name of hernia cerebri, the ring is bony, and here strangulation occurs on a like principle, viz., the same swelling of the protruded parts that can alone explain the nature of abdominal strangulation. Indeed we find no muscular fibres competent to contract on the ring, in either of the three localities in which hernia ordinarily occurs. And the occurrence of ordinary ventral hernia, in which the contents escape through an aperture formed in the abdominal muscles themselves, is hardly an exception to this law, because there is usually a deficiency of muscular fibres at the part to which the existence of hernia may be referred. If we imagine a portion of intestine to escape through an opening, involving each of the three layers of these muscles, and exercising an active contraction on the protrusion, we should have a condition of parts essentially different from that which commonly attends the disease, when occurring in the ordinary situations. In truth, this antiquated doctrine, which has too long, for the welfare of humanity, referred the cause of strangulated hernia to spasm of the muscles, is almost exploded, and with it the numerous class of supposed remedies attendant in its train.

No muscular contraction.

*Symptoms of Strangulated Hernia.*—First, a tumour at the situation of a natural opening, inguinal, femoral, or umbilical; if not of recent occurrence, at least of greater than usual magnitude. Second, the patient will generally himself date it to some hour, or from some occurrence, since which he has suffered greater pain or inconvenience than usual. Third, a sense of local tension. Fourth, a drawing or dragging sensation, extending upwards, towards the back of the abdomen, where the intestine or omentum is naturally fixed. Fifth, nausea in the earlier, leading to vomiting in the later stages. With regard, however, to this symptom, I may observe that sickness in the early stage of strangulation is almost exclusively confined to that of the small intestines. Sixth, constipation of the bowels from obstruction to the tube of the intestine.

With respect to the first of these symptoms, the tumour may be of any form, or of any size, embracing all magnitudes, from that of a hazel-nut to that in which two-thirds of the entire mass of intestine is pushed beyond the walls of the cavity. It is in the lesser degrees of the disease that the nicer discrimination is demanded by the surgeon, those cases of recent occurrence in early manhood, which are the product of great and sudden muscular effort, that are perhaps more dangerous in their character and demand more promptness in their treatment. In the case of inguinal hernia of recent occurrence, a small tumour may have escaped from the abdomen, without having made its appearance in front of the walls, and is, in fact, compressed between them at some distance from the surface. The tumour, under these circumstances, is scarcely apparent to the eye, and presents little more than a mere fullness along the line of the inguinal canal, and only detectable by a comparison with the same region of the opposite side. These are cases of real difficulty, and which require the eye and the judgment of the experienced surgeon. The general symptoms should be weighed with all nicety. Supposing the occurrence of the disease recent, we fail in the evidence of one most important symptom, viz., constipation; or indeed temporary constipation may attend on other painful diseases of the groin besides hernia. Still, if the swelling be positive, however small and difficult of detection, and the other symptoms bear out the evidence of hernia, we are compelled to operate.

Diagnosis of recent cases.

Several of such cases have occurred to me, as well as to others, presenting difficulties, which can only be met by the application of a defined principle of action. It would be better to cut down unnecessarily on ten tumours bearing the evidence of hernia, than to omit to bring one true hernial tumour to the test of the knife. For it must be recollected, that the operation suggested is not the operation for strangulated hernia, but merely an exploration preparatory, if necessary to the operation itself. It may require but a division of the integuments and fascia, till on exposing the disease, we possibly exhibit an enlarged gland, and the operation is concluded.

Cases for exploration.

Such a case occurred to me in St. Bartholomew's Hospital. A man was brought in having symptoms of strangulation, with a tumour in the groin. My colleagues and myself were unanimous in our opinion of the existence of hernia. In the absence of Mr. Lawrence, who had, however, seen the case, and recommended the operation, the duty devolved on me. I exposed the tumour, which proved to be an absorbent gland. This man had local pain, sickness, and constipation.

Form of inguinal hernia.

In reference to the question of form, although we have no positive assumption to rest upon, for the form of the tumour must hold, more or less, a relation to its size, yet the variation in form is less than in that of the other quality referred to. In hernia of the canal, the figure of the tumour compressed by the aponeurosis of the external oblique, must be obtuse and ill-defined, but its depth will, in some measure, point to its nature, inasmuch as that any other disease in the canal is of far more rare occurrence than hernia.

Any form of hernial tumour, whether oblique or direct, presenting below the external ring, being compressed by the pillars of that opening, will necessarily be more or less constricted by them, especially in the early stages of the disease. From this part downwards, therefore, the tumour assumes an elongated form, however great its magnitude.

Form of a femoral hernia.

The form of a femoral hernia is less definite than the inguinal variety. It is said to extend across the thigh in the transverse direction. This is by no means a general law, nor is it even common; it is only occasional; and still less rarely is it pushed upwards fairly over Poupart's ligament, as is frequently described. It is, however, often somewhat longer in the transverse than in the longitudinal direction, and by this sign alone it may be occasionally distinguished from inguinal hernia. Umbilical hernia is too definite in its characters to render description requisite.

Dragging not constant.

The sensation of dragging from the back is not the attendant on all forms of hernia. It is caused by the tension of the mesentery or mesocolon, which are forced down with the intestine, and attached by the upper extremity to the region of the lumbar vertebræ. In early or recent hernia, this tension is inconsiderable, consequent on the limited descent of the intestine, and is only well marked in those forms of the disease, in which the descent is large in volume, then this symptom becomes very prominent.

With respect to the question of constipation, the discharge of the contents of the large intestine below it, is, of course, not incompatible with its presence. I have known this discharge in a case of hernia, to be very copious, sufficiently so to have misled for the time the judgment of the most experienced.

Symptoms modified in omental hernia.

Most of the above indications are considerably modified in the case of the descent and retention of omentum alone. The general sense of uneasiness is less marked, sickness more remote, and pain more obtuse. But the constipation may be as complete as in the case of intestinal hernia.

Evil of protracted operation.

I believe it may be asserted, without fear of contradiction, that the danger attendant on the operation for strangulated hernia, is nearly in proportion to the period of the strangulation. Within the last quarter of a century, the treatment of that disease has undergone a considerable improvement, founded on an advanced pathology. Within my own recollection, many hours, even a day or more, was allowed to elapse, for the purpose of bringing into action many worthless remedies that were inoperative to any purpose but that of reducing the small chance of the patient's recovery, by wasting the precious hours during which the operation might have been undertaken with a prospect of success. The profession had a routine of remedies which were resorted to in a given order of succession, and until they were exhausted, it was not deemed right to have recourse to the only remedy that could be available to a successful result. The taxis, warm bath, taxis repeated, cold affusion, the local application of ice, taxis repeated, the tobacco enema, and, finally, more taxis, and then the operation. Thus twelve hours were wasted in the employment of remedies infinitely worse than merely useless, with every hour increasing the danger from the advance of inflammation of the intestines and peritoneum, and from the great draught on the vital powers.

The taxis.

The taxis is an obscure word, derived from the Greek word, to "put in order," but conventionally signifies to knead, thrust, or pummel with the hand or fist; and most vigorously was the principle carried into execution. During the twelve hours of treatment, prior to the operation, possibly one full hour was devoted to the endeavour to disorganise the delicate textures within the sac, and certainly the occasional recoveries after the operation, testify that it was not invariably successful. The term, which is associated with the above practice, is nearly as obsolete as the practice itself. The attempt to return the intestine should, doubtless, be efficiently made by the hand of the surgeon, but employed with all gentleness. Pain is inevitable; but there is a manner of giving pain, when necessary, that at least renders it bearable by the patient. I am not aware that what one surgeon has failed in, by the employment of judiciously applied pressure, another surgeon can effect; while I am quite sure that every succeeding attempt that is unsuccessful adds to the patient's danger.

**Avoid pressure on the ring.**

In order to apply this pressure by the hand with the best effect, the tumour, if in the scrotum, should be raised on the hand and moved circularly in all directions, and a piece of the tumour pinched up, so as to act on the contents without forcing the mass against the ring. Occasionally success will attend the sudden remission of pressure on the ring, while the tumour is compressed by the hand below. An old practice prevailed in the last century, and recommended by Winslow, of placing the patient with inguinal hernia, on his knees, and leaning forward, during the effort at reduction by the hand, and the position is not a bad one. I have myself adopted a rule for many years, not to attempt reduction by any persistent effort, after having ascertained that a previous attempt has been judiciously made by a competent man. Every half hour increases the difficulty, and its repetition is almost certain to prove nugatory.

Warm bath.

After the attempt to return the intestine by the hand, a warm bath may be resorted to; but it is, in my opinion, of doubtful efficacy; and before the patient's removal from which, advantage being taken of his position, the effort may again be made with the hand. The length of time awarded to these agents will greatly depend on the urgency of the symptoms. If the hernia be of recent occurrence, the attempt will be painful, and the symptoms oppressive to the system. The presence of local pain, of nausea, or vomiting, if his features betoken suffering or prostration, if he shrink from the contact of the hand, or betrays restlessness and discomfort, the sooner the operation be performed, the greater his chance of recovery. If on the other hand, the pain be moderate, if he bear the pressure of the hand without shrinking, if without nausea or anxiety of countenance, the operation may be postponed for a few hours, and renewed efforts may be made to replace the intestine. But these efforts can be but a repetition of the former. Four to six hours from the date of strangulation is perhaps the longest time allowable for the postponement of any operation for hernia.

In the attempt to reduce a large umbilical hernia, I have occasionally succeeded by raising the whole tumour, and shaking it with some violence. The fingers of each hand may be pressed in under the tumour, which should then be forcibly raised, as though in the attempt to raise the abdomen off the bed; and even this practice is not so injurious as the kneading process adopted by the old school of surgeons.

Application of cold.

With respect to the application of cold, I have seen benefit derived from the copious injection of iced or cold water into the large intestine, but rarely, if ever, from its external application.

The tobacco enema is deservedly exploded by all good surgeons of the present day.

In addition to the above remedies, the old surgeons employed drastic purgatives by the mouth. The object, one would presume, was the endeavour to drag up the bowel from the sac by the mechanical influence of the medicine on the intestine. I have never seen the smallest benefit to arise from their administration, and on every principle should strictly abjure their employment.

Operation.

When these agents fail to effect a return of the intestine into the cavity of the abdomen, we have no alternative but the knife. The immediate object of the operation is that of dividing the stricture, to employ again a term that is not always applicable, for frequently there is, correctly speaking, no stricture. It should rather be described as that of enlarging the opening through which the unusually large mass of intestine has escaped.

To effect this object, the parts must be divided from the surface down to the stricture, in succession. This is an act of deliberate dissection. The external incision should be made in the axis of the tumour, and of sufficient length to command the parts within with facility, but still its dimensions should be moderate. There can be no necessity for carrying the incision along the length of the tumour, if large, when our operation concerns the neck alone.

Question of division of the sac.

The operation for hernia has been, of late years, greatly improved and simplified by leaving the sac entire. It is urged, by its advocates, that the danger of the operation is thus materially lessened, that inflammation is less probable, and recovery more general. Common sense would certainly revolt from any practice that was acknowledged dangerous as compared with another that was positively less so, whatever the theory or principle involved. This feature in the operation for hernia has for many years been especially advocated by the late Mr. Aston Key, Mr. Luke, and my colleague, Mr. Lloyd, who have given decided testimony in its favour, and its general, though not invariable adoption, has become the established practice of the surgical profession. Still the fact, though undeniable, does not appear very readily explained.

Although the mortality after operations for strangulated hernia is less when the sac is not opened than when it is, it does not necessarily follow that it is from the injury done to the sac, by dividing it, that danger emanates. The mortality consequent on dividing the sac may *possibly* be attributable to the exposure of the intestine to the air, or to the more protracted nature of the operation, or to the immediate contact of the hands with the intestine. It appears to me that we are justified in looking wide for an explanation of the unquestionable success attendant on this practice, when we consider the evidence obtainable on the opposite side. Some of these arguments are enumerated in the following. The sac of an old hernia especially, although continuous with, and originally forming a part of the peritoneum, holds no relation with it in function, has become very dissimilar to it in structure, and takes no part in the diseases and liabilities of the parent membrane. Its diseases are its own, and as such, are incommunicable to the general membrane within. How often do we meet with abscess in the sac after operations for hernia, to which we attach no idea of danger, because we know that the line of junction precludes the transmission of suppurative action extending within the cavity; as in a case of phlebitis, the inflammation of the lining membrane often ceases at the junc-

Arguments in favour of division.

tion of the first large branch. We never observe, on the other hand, that peritonitis extends from the membrane into that portion of it that constitutes the hernial sac.

Again, although inflammation of the peritoneum extends by *continuity* of surface, its extension by *contiguity* is yet more positive. We do not trace inflammation of this membrane extending from the divided sac as the centre of mischief; if we usually did so, the fact would be notorious, and the pathology acknowledged; but, on the other hand, the gut itself should rather be deemed the centre or focus of inflammation, when carried back into the midst of the intestines, already prone to inflammatory action, by reason of the interruption given to their natural functions. This extension by contiguity is palpable by the lines of adhesion, and the tinge of discolouration formed on all the intestinal surfaces contiguous to each other. If peritonitis have any recognised point of origin, it is in the inflamed intestine, and undoubtedly there is no comparsion between the degree of inflammation affecting the peritoneal lining of the intestines and that lining the walls with which the sac is continuous. In order to produce general peritonitis, when originating in the divided sac, it must travel over the entire half of the abdominal walls, to reach that portion of the membrane which examination after death exhibits as most highly inflamed.

All authorities on hernia describe cases, the strangulation of which occasionally depends on thickening of the sac itself. If the intestine, in such a case, and I have myself had many, be returned into the abdomen still entangled in its own stricture, death must follow. It would appear reasonable that the difficulty of returning a large mass of intestine into the abdomen, unless the sac be opened, is greatly increased, for we lose the advantage of taking the intestine piecemeal, and replacing it by the gentle form of manipulation I have above described. In fact, it requires to be thrust back in mass, and the difficulty in effecting this must often be great.

Notwithstanding the above arguments which, whatever their pathological value, do not materially influence the operation selected, the practice of leaving the sac unopened has become general in all cases where it is practicable. And doubtless the operation is greatly simplified by its avoidance, not only because the occasional difficulty of dividing the sac is removed, but because the extent of the required incision is greatly reduced, and the exposure of the protruded mass by elaborate dissections of the surrounding textures is avoided. The inquiry of the last five years has fully confirmed the statements made by the advocates of non-division of the sac, and the fatal results of the operation have been greatly abridged in number. The large experience of Mr. Luke in the London Hospital, who was among the first to express his conviction of the value of non-division, as well as that of some other leading surgeons, have contributed much to its more general adoption, and it may be said to have become the rule of practice rather than its exception.

But these ends are not invariably attainable under the best management, and cases are not rarely met with in which, notwithstanding every precaution, we are compelled to open the sac. In old herniæ, when the stricture is not palpably referable to the structure of the rings; or at least where it cannot be sufficiently divided without the operation being greatly protracted; or again, in cases which present the indication of positive loss of vitality of the intestine; or whenever the stricture being apparently divided, the protruded mass cannot be returned,—then the sac should be opened, whether for the purpose of exposing an intestine probably gangrenous, or of removing at once the real cause of the constriction; for it cannot be denied that, in the dissection of parts from without inwards, we divide structures not essential for the return of the protrusion, whereas by the division of parts from within outwards, we divide that only which is the immediate cause of strangulation.

## INGUINAL HERNIA.

Anatomy of inguinal hernia.

Any general description of the anatomy of hernia would be irrelevant to the purposes of this work; yet I may be permitted to recall to the reader's attention a few of its more prominent features, and I commence with inguinal hernia. Poupart's ligament, which divides the line of the abdomen from the thigh, is stretched across, from the anterior spine of the ilium to the spine of the os pubis.

The aponeurosis of the external oblique is connected to its upper surface, and forms the external ring, close to the os pubis. The internal oblique and tranversalis muscles arise from the outer half of the ligament, and their lower edge descends nearly parallel to it, becoming tendinous, and being attached to the os pubis behind the ring which they thus assist in closing. The fascia transversalis, constituting the third layer, is connected to the whole length of the ligament, from which it ascends between the transversalis muscle and the peritoneum to the extent of two or three inches. At a distance of about one inch and a-half obliquely outwards from the external ring, nearly along the line of Poupart's ligament, and immediately above it, this fascia is perforated by the spermatic cord, receiving from it a funnel-shaped process of fibrous tissue, which immediately invests the cord along the canal. Passing below the internal oblique, the cord receives the cremaster muscle, continued upon it down into the scrotum; and, lastly, reaching the external ring, the cord descends, lying on its outer edge, and from which it acquires an additional fibrous investment from the pillars of the ring.

Epigastric artery.

Behind all the parts yet alluded to, the iliac artery gives off the epigastric, which curves along the inner side of the opening in the fascia transversalis, hooking round the spermatic cord to ascend towards the mesial line. Such is the relation of this artery to the cord, that it will always be found to its inner side, and immediately in contact with it, whether the opening be small and placed nearly mid-distance between the attachments of Poupart's ligament, or whether in old hernia this internal opening be dragged towards the mesial line behind the outer ring.

Direct hernia.

This general view of the anatomy of oblique inguinal hernia will suffice for my purpose. The intestine descends along the line of the cord, raising from off it its various investments of muscular and fibrous tissues. A modification of this form of oblique inguinal hernia, consists in a protrusion of intestine under the *tendon* of the internal oblique muscle, through the external ring. The greater liability to the occurrence of this modification, called *direct* or *ventro inguinal*, depends on the greater or less development of the tendinous insertion of the internal oblique muscle behind the external ring. *Oblique* hernia lies upon the cord from which it has separated the coats; *direct* hernia, on the inner side of the cord, having no common investment with it, but that which both derive from the external ring. The epigastric artery lies a full inch to the outer side of the opening through which direct hernia occurs. The seat of stricture is at the lower border of the internal oblique in both these forms of hernia; or, to speak more correctly, the division by the knife of the lower border of the muscle or its tendon, will remove the stricture, and not that they alone cause it. The cause of stricture is a general one, but in this direction we may divide it with the least difficulty or danger. By dividing the muscle straight upwards, we avoid the epigastric artery, whether in oblique or direct hernia.

Division straight upwards.

A description of inguinal hernia is not infrequently met with, in which, in the course of the operation, on the sac being opened, the testicle presents itself at the bottom of an elongated cavity. This form of the disease is called *congenital* hernia, the intestine having followed the track of the testicle in its original descent from the abdomen into the scrotum. But examples occur in which this disease first appears at manhood, and are explained only by supposing either that the testicle must have descended late in life, or that a portion of omentum may have passed down with it at the time, and retained the continuity of the passage with the abdomen.

Congenital hernia.

Although the distinctions between inguinal and femoral hernia are usually made without difficulty, yet cases occur in which the distinctive characters of the two are not readily observable. The question is settled by tracing the line of Poupart's ligament, which passes *over* femoral, and *under* inguinal hernia. Inguinal hernia is the prevalent form in the male; femoral, in the female. Inguinal is longitudinal; femoral, obtuse, rounded, and sometimes transverse; but the difficulty is most readily removed by tracing the line of the ligament by the hand. Inguinal hernia may present itself in the form of a slight swelling, or fullness of the canal; or in that of a bulky tumour, occupying the scrotum. In whichever form it appears, the axis of the tumour is the guide for the first incision.

External characters of inguinal and femoral hernia.

*Operation for Inguinal Hernia without Division of the Sac.*—This operation consists in the dissection of the structures over the neck of the sac only, and commences by an incision determined, not by the size of the protrusion, but by the probable depth of the ring from the surface. By examining the protruded mass, the point of its junction with the abdomen is ascertained without difficulty; and this point constitutes the region on which the attention of the operator is concentrated. The skin being shaved, the integuments are divided by an incision, varying from about two to three inches in length, and without further reference to the anatomical relations of the parts involved. The fibrous bands that cross the neck of the sac are in succession divided, whether by being forcibly raised with the forceps, or by the aid of a full-sized director passed beneath them. Every band, even to that of the smallest size, is necessarily divided, or the obstacle remains. When the division is complete, the contents of the sac may be returned, and the wound united, whether by plaster, by suture, or by both.

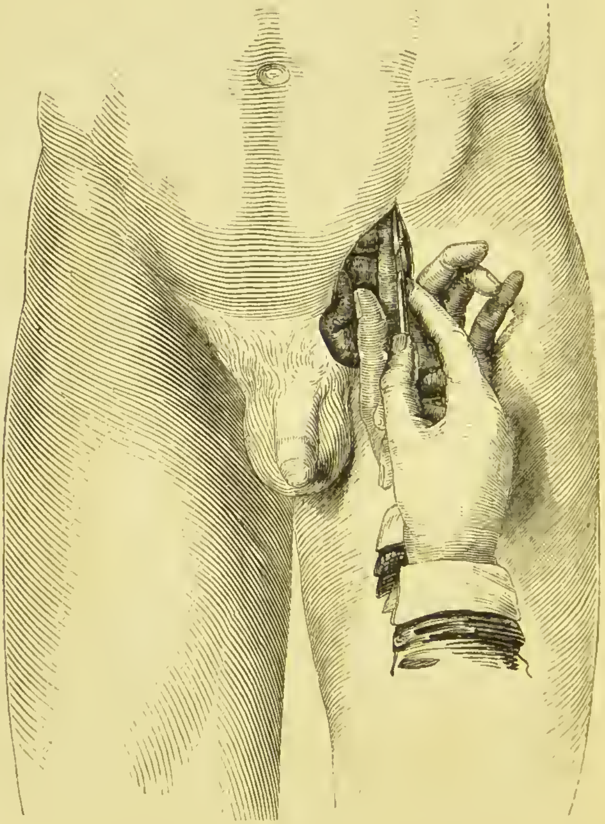
When the protrusion is large, and the hernia of many years' duration, the difficulty of the operation will be increased, unless the external incision is sufficiently ample to give free scope to the required dissection; for, although the constriction may especially depend on one single band of fibrous tissue, and that the lowest of the whole aponeurosis, yet all are involved in the relation of causes more or less proximate to the effect, and all must be divided. It is important that the outer wound be kept clean, and the structures to be divided thoroughly exposed by the assistant.

*Operation with Division of the Sac.*—In the longitudinal tumour an incision is made, commencing half an inch above the situation of the external ring, and carried downwards on the tumour to an extent proportioned to its size. If very large, it may be prolonged to four inches in length, or even longer; if in the canal, before it has reached the external ring, the incision should take nearly the direction of the canal, or parallel to Poupart's ligament. Taking the first form as the supposed example, the skin may be divided by a fold, being raised between the operator and the assistant, and cut directly through, either from the skin downwards, or by puncture

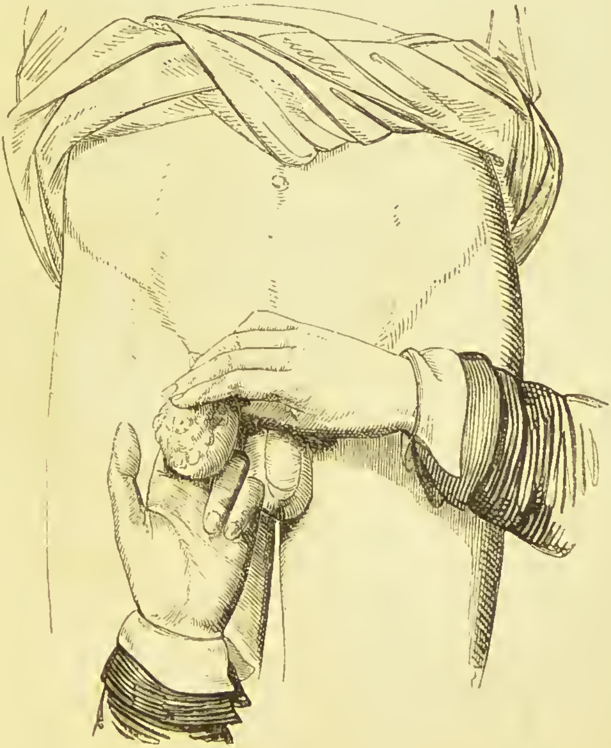
Oblique or direct?

from within outwards. The incision thus made should fall into the required line. The division of the textures below should be carried on, till the layer of fibres arising from the external ring is divided; and at this stage we ought to be enabled to tell whether the hernia be oblique, or direct; for hitherto the investments would be held in common by the two. If it be oblique, the cremaster muscle will present itself, covering the tumour, and the cord will not be seen, from its position behind it; if it be direct hernia, the cremaster will retain its relations to the cord, which will lie to the outer side of the hernia.

In the case of oblique hernia, the layer comprising the cremaster muscle is next to be divided, and the funnel-shaped fascia from the internal ring, or in that of direct hernia, the prolongation form of the fascia transversalis,



and the sac is exposed. If the hernia be large, the different layers as they are exposed should be divided nearly to the extent of the external wound. The sac may be opened by pinching up a point by means of a fine pair of forceps, or raised by means of the tenaculum. A gush of fluid follows, often in considerable quantity. The sac is to be slit up, to the extent of the other membranes, and its contents examined. The omentum, if not adherent, should be opened, and the intestine will lie behind it. The degree of tension of the ring should be examined by the finger, and a director introduced upon the omentum into the abdomen, great care being taken to depress the intestine, and to keep it out of danger. The knife invented by Sir A. Cooper, and which bears his honoured name, is then passed into the groove, and through the ring, into the abdomen, on its side. Reaching its destined height, the edge is turned straight upwards, and the obstructing margin divided to an extent proportionate to the size of



Intestine to be first returned.

the mass to be returned. The contents of the sac are then to be replaced in the abdomen, always beginning with the intestine, and ending with the omentum.

The index finger should be introduced through the ring into the abdomen *underneath* the bowel. In the act of introducing it, a portion of intestine, nearly of the length of the finger introduced, will slip up, and should be retained by slight pressure from the other hand. If the palm of the hand first employed be expanded to receive the protruded bowel, the operator will be enabled better to appreciate the line of the intestine, which should be kept moderately tense below the ring, in order that it should pass longitudinally, and without fold, through it, and that too much of its length should not be attempted at one effort. Care should always be taken that the contents of the intestine pass with the intestine itself, otherwise we are subject to an accumulation of the intestinal contents towards the end, and the return of the last few inches is rendered extremely difficult. When, in operating for hernia, the large intestine is involved, it is better to puncture the intestine by means of a fine needle, and let out the contents, than to make rough or protracted efforts to replace it. I have frequently done this with advantage.

When each is thoroughly returned, the finger should be passed gently into the cavity, for the purpose of pressing the bowel, as far as possible, from the neighbourhood of the ring, and thus tending to prevent its immediate return. We are often troubled to know what is best to be done with the omentum, when the intestine is returned into the abdomen. The condition of the omentum, as well as the quantity remaining in the sac, are important elements in this decision. If the quantity be small, healthy, and unconnected to the sac, and the opening sufficient to enable the surgeon to return it without difficulty, there is no excuse for removing it. If adherent to the sac below, in the case of a large cavity, and especially if it be altered in structure by being thickened,—and I am not familiar with the changes alluded to by some authors, and especially by Velpeau, who speaks of its being, in some instances, as largely charged with fat, becoming twisted, clustered into *pelotons,* and forming hard tumours, similar to scirrhus,—it is reasonable to infer that its return into the abdomen might be a source of. evil. Under these circumstances it is better removed than returned.

Removal of omentum.

The quantity to be taken away should be regulated partly by the condition of the membrane, and by the necessity of reducing the protruded mass as much as possible in relation to the outer wound. In the rare cases in which the omentum is gangrenous, its entire removal beyond the dead structure is inevitable. If the omentum above the divided edge be healthy, it may either be returned into the abdomen or left in the wound. When cut asunder, the healthy omentum will often bleed freely; whereas, we can divide large masses of the membrane that has been subject to long pressure, and has undergone the changes incidental to it, without the application of a single ligature. Whatever vessels are tied, should be secured singly, with fine silk, and the threads cut off closely. As a general rule, it is perhaps better, if it be necessary to divide the omentum, unless perfectly soft and healthy, and especially so if several ligatures have been employed, to leave the cut surface in the wound and occupy the ring, instead of passing it up entirely into the abdomen. If cut close, the omentum will probably become adherent to the margins of the ring, and render the recurrence of hernia somewhat less probable. It is not, however, so definite a point of practice as to justify a very positive opinion.

Cæcal hernia.

Very troublesome cases of inguinal hernia occasionally present themselves to the surgeon, in which the protruded intestine consists wholly of cæcum. This portion of the large intestine may present itself, deprived of a sac, consequent on its anatomical relations while in the abdomen. In such cases, the peritoneum lining the walls of the cavity are reflected over the mesial surface of the bowel, leaving the outer surface, which lies low down in the iliac fossa, entirely uncovered by the membrane. If, in such examples, hernia occurs, this intestine is protruded by that surface which is nearest to the ring, and consequently it descends without a sac. The difficulty that attends these cases of cæcal hernia, consists in that of the retention of the bowel, when returned into the abdomen. If the bowel be replaced, it immediately falls again through the ring, and, indeed, it is not invariably in our power to replace it, from its adhesions around the neck of the tumour. Thus it becomes inevitable, after freely dividing the stricture, to leave the intestine outside the abdominal cavity, and to provide it with integumental covering as speedily as possible.

*Hernia Strangulated in the Canal.*—We meet occasionally with cases of recent occurrence, in which strangulation has appeared early in the progress of the disease. The tumour is necessarily small, being bound down by the aponeurosis of the external oblique muscle. Its situation is above Poupart's ligament, and between the two rings. The incision should be made along the line of the canal, about half an inch above the ligament, two inches in length, and the skin and superficial fat and fascia divided. By this incision the superficial epigastric artery is cut asunder, and should it bleed may be at once tied, if the flow of blood cause obstruction to the operation. The aponeurosis of the external oblique muscle is to be divided to the extent and in the direction of the external incision, upon a director. The cremaster muscle will then present itself, expanded over the hernial tumour, which has raised it from the front surface of the cord. This muscle and the funnel-shaped fascia produced from the internal ring are then divided, to an extent sufficient to bring the tumour clearly into view, covered by its sac. In this case, of recent occurrence, it may be practicable to return the intestine through an unopened sac, and the attempt may and ought to be made, and in this condition of the parts so recently displaced, and probably so unaltered in texture, the sac may be returned with the bowel into the abdomen.

Superficial epigastric artery.

Cremaster muscle.

Sac unopened.

Splitting of the cord.

A peculiar feature occasionally presents itself on exposing the sac in an operation for hernia, viz., that the cord is separated into its component parts, some of which may lie in front of the intestine, others at the side. These relations, indeed, when the cord is so split, may assume any variety of arrangement. Although it is necessary to know that such varieties exist, it demands no further observation here, beyond that of enjoying especial care that such textures be uninjured in the after steps of the operation. Inasmuch as the cord will, in all probability, be more or less attached to the sac, there can be no advantage derived from their separation by the knife.

**Discoloured intestine.**

On opening the sac in hernia, the intestine may assume any variety of colour or appearance between that of health, and that of gangrene. This variety includes all the colours incidental to every degree of inflammation or congestion. True gangrene of the gut is a rare occurrence, and is only found after several days' strangulation. It is very important to distinguish between extreme congestion of the vessels, and the death of the intestine. In the latter, the structure assumes a slate, or even nearly a black colour, in patches; it has entirely lost its polish; its surface is filamentous; it presents a smell of fœtor, and when advanced, even the integuments above are involved in the diseased action, and bear testimony to the altered condition of the parts within. When the bowel is gangrenous, there is no doubt of the fact in the mind of the observers. It is apparent and unequivocal. This condition of the intestine is not to be confounded with a high degree of congestion of the vessels, rendering the intestine almost black in colour, although a question may arise in the latter condition of the parts, as to the existence of gangrene.

**Gangrene.**

The treatment to be adopted in cases in which gangrene of the bowel is palpable, will depend much on the extent of the gangrened surface. It is very rarely that we find its entire calibre involved in the change, or that the patches are very large. When the patches are very considerable in size, or involve the entire tube, the puncture of the intestine is inevitable, because little hope can exist of its restoration if returned into the abdomen. But if the appearance of gangrene be not considerable—if it exist in spots or patches of a size not much larger than half an inch in diameter, although not limited to two or three—then the course to be adopted is to replace the intestine, with something more than usual care, into the cavity of the abdomen, and to trust to Nature for its restoration. And this she will inevitably do under circumstances of health favouring the process of union of the gangrenous spots to the surrounding membrane. This practice has been adopted for many

**Laying open the intestine.**

years by Mr. Luke with success, and it constitutes an important step in the onward march of sound conservative surgery.

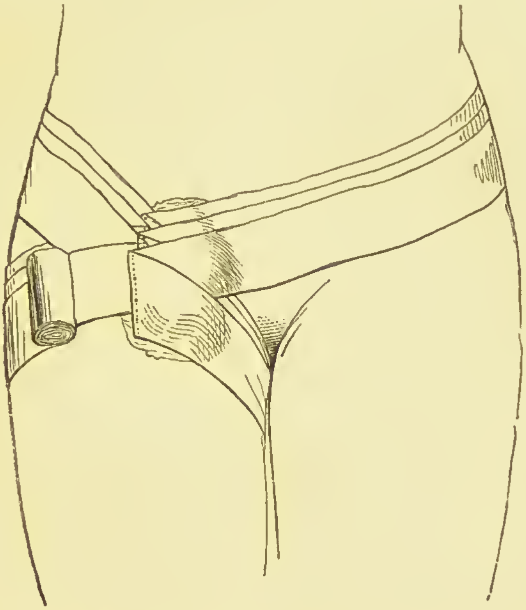
When dependent on congestion of vessels, the intestine, however unpropitious in appearance, is often restored to a healthy colour with wonderful rapidity. Case. I operated on an old man for hernia, in the Charter House. The quantity of intestine in the sac was very large, and, I think, more highly congested than I had ever seen it. The first impression on my mind was that it had lost its vitality; but it was free from fœtor, and had not lost its polished surface, or become filamentous, and the discolouration was universal, and not restricted to patches. Under these circumstances I returned it into the abdomen. The man progressed favourably; the wound, which was very large, healed quickly to within three-quarters of an inch of its length. At the expiration of the third week, during a violent fit of coughing, the action of the abdominal muscles forced the intestine down into the sac, tore open half the wound, and thrust at least four feet of intestine out upon the abdomen, no part of which bore testimony to its previous discoloration.

Wound of intestine. In operations for hernia, a small opening in the intestine occasionally presents itself, giving very unequivocal evidence of its involving the entire coats of the bowel, by the oozing of the fluid contents through it. The wound has all the appearance of a recent injury; but against this view of the subject, the operator, who ought to be the best authority, invariably asserts that he did not divide even in the direction of the wound, and no one can declare that he did, and in our profession none will venture to suspect the instrumentality of the operator, against the evidence of his own unimpeachable testimony: therefore, it is concluded, that the intestine was torn in drawing it down, or referable to some other unexplained and mysterious cause. Such at least was the line of argument followed in a case in which I was myself the possible delinquent.

After all, the injury is not very great. The wound should be united by one or two threads, passed through the serous and muscular coats only; and the intestine may be safely returned into the abdomen, even though the wound be not entirely closed by the suture. The patient I allude to, recovered.

Large but soft pressure.

When the above stages are concluded, the outer wound should be united by the interrupted suture, deeply introduced in loose integuments, great care being taken that the ring be kept free from intestine. A pad of lint should be placed over the ring, and over the pad a large handful of cotton wool, or in its absence a folded towel or masses of lint, so applied as to compress the ring from below, without involving the walls of the abdomen. Over these, a bandage should be dexterously applied, like the figure of 8, passing round the abdomen and the thigh of the affected side, fixed by a needle and thread, or by pins at every turn, as it passes over the compress, and from that point carried back, and not onwards. By this means the compress will form the centre of pressure.



After-treatment.

As regards after treatment, it should be, for the most part, passive. If the sickness subside, and the bowels act quickly, it is a favourable omen of recovery, but should some hours elapse without action, it is no excuse for the administration of drastic purges. It is difficult to lay down any specific rule on this subject, so various may be the indications, but I believe it is better to leave a patient alone. If, however, at the expiration of thirty-six or forty-eight hours no action appears probable, a mild aperient may be given, in the form of manna with some compound decoction of aloes, or mild form of neutral salts with some tincture. The intestine may also be excited to action by enemata of warm water with salt, or other mild purgatives, not to be repeated with too great frequency. It is the practice of many surgeons to administer a dose of opium immediately after the operation, and, generally speaking, it answers well, an important indication. It removes pain, promotes sleep, tends to equalise the circulation, and thus lessens the liability to local inflammation. The only objection to be urged in its disfavour is its tendency to postpone the action of the bowels. But this evil can scarcely be supposed to counterbalance the benefit to be derived from its administration.

Inflammation, if at all, will probably not appear before the day but one following, *i. e.*, forty-eight hours after the operation. It is very essential that we distinguish the general pain and uneasiness about the abdomen, attendant more or less on all operations of this region, and which are very deceptive in character, from the signs of true inflammation.

Symptoms of true inflammation.

In the endeavour to distinguish between the signs of true and false inflammation, I must again refer to the equivocal marks of the one, and the conclusive characters of the other. True inflammation can hardly be mistaken. Pain in the abdomen, at first confined to a region, but becoming general; increased in proportion to the degree of pressure of the hand, and not suspended or forgotten when the patient's attention is directed to other subjects, under which circumstances the same pressure often affords relief in false inflammation; or, at least, the pain in such instances bears no proportion to the extent of the pressure: hot skin; pulse small, but hard, and more than usually frequent, though far within such frequency as shall characterise simple disturbance of the nervous system, when it may beat from one hundred to one hundred and thirty pulsations in a minute; restlessness, without movement; anxiety of countenance, distinctly marked and expressive of suffering; the knees drawn up, and the body bent forwards, in order to relax as much as possible the abdominal muscles—these are the symptoms that mark the progress of true peritonitis. The mock symptoms may make their appearance on the day following the operation, or at any time; and may be allayed by such remedies as are applicable in any other case of nervous disturbance. The true peritonitis may, I believe, be developed by the unnecessary resort to active depletion. I think I have seen it frequently productive of much serious mischief. I believe that we render persons more liable to such inflammation by the resort to any agent that tends to lower the tone of the nervous and circulating systems, and that we should be very careful how we employ these agents of depression. If they effect no good, they perpetuate a serious mischief. *The more we bleed, the more prominent do the symptoms appear,* and in the same ratio with the loss of blood. The same remarks will apply, though in a lesser degree, even to the treatment of true inflammation. Nothing can be more injurious, and more probably fatal, than the large application of leeches applied to the abdomen in our public hospitals, for the cure of peritonitis—real or supposed. For many years past, having had abundant opportunities of observation, I have observed that the recovery of a patient who has been subjected to the repeated application of these agents of mischief is rare indeed.

Symptoms of false inflammation.

Evils of great depletion.

When the symptoms of positive inflammation appear, and when there is nothing in the present condition or in the system of the patient to preclude it, he may be bled once moderately from the arm; or locally, by the application of one or two dozen leeches; his system being at the same time sustained by mild stimulants, and from that time I believe our reliance should be placed on mercury, conjointly with opium, given freely. Of these two last-named remedies, I do not know which is the more valuable in the treatment of such a disease as peritonitis. With respect to the influence of mercury, its agency is sufficiently recognised throughout the profession; but not so as regards the action of opium, and I look forward to the time when its employment in inflammation will raise less alarm in the public mind than it does at present. The action of mercury may be

Mercury with opium.

obtained both by the mouth and by inunction; and, in reference to the latter mode of administration, a mass of the ointment of the size of a hazel-nut may be slightly rubbed in each axilla, and left for absorption.

## FEMORAL HERNIA.

In well-marked cases there is no difficulty in distinguishing the varieties of inguinal from femoral hernia. But examples occur in which a correct opinion can only be arrived at by somewhat more than usual observation. Diagnosis. To obtain this essential knowledge, we must carefully examine the relations of the external parts, and endeavour to trace the line of Poupart's ligament, descending to the spine of the os pubis, and to follow the hernia up to its neck. If femoral, the protruded mass will appear below the line of Poupart's ligament. If inguinal, above it—and we derive some knowledge also from the usually distinct forms of the two varieties, as elsewhere described. Moreover, in inguinal hernia in the male, the scrotum is necessarily involved in a greater or less degree.

Anatomy. Femoral hernia descends through an aperture left between the femoral vein on the outer, and the crescentic fold of Poupart's ligament, called Gimbernat's ligament, on the inner side. This opening in the natural state is about sufficiently large to admit of the extremity of the little finger. Sir Astley Cooper speaks of it as being occupied by an absorbent gland. If so, the presence of the gland is the exception, and not the rule. Poupart's ligament bounds this aperture in front; the femoral vein on the outer side; Gimbernat's ligament on the inner side; and behind is the continuous layer of fascia descending from the iliac fossa, and covering the bone and pectinæus muscle, to become fascia lata. The hernia lies on this portion of the fascia lata, which is connected yet more internally to the os pubis. This aperture is called the femoral ring, and forms a part of the general opening, through which the vessels descend from the pelvis into the thigh; but the vessels on the outer side are invested by a sheath of fibrous tissue, which descends upon them down the thigh. The hernia cannot be said to enter into this sheath, but to lie on the inner side of it, in consequence of the sheath which invests them not being derived from the entire of the crescentic oval cut for the descent of the vessels, but only from that part of the oval with which they are in contact; viz., the outer two-thirds. This small aperture is filled with cellular tissue, which by the descent of the intestine is shaped into a coat, generally called, though by no means universally, the *fascia propria.*

The investments of femoral hernia, as found in dissection, are simply the superficial fascia, as it is termed, placed between the integuments and the fascia lata, and the above-described fascia propria. But the operating theatre often discloses to the view a laminated texture, similar to that of inguinal hernia, and consisting occasionally of several layers of fibrous membrane, each of which has to be divided in the operation.

Obturator artery.

The epigastric artery is at a distance above the neck of the sac, and behind the flap of the abdominal muscles, and holds, therefore, no relation to femoral hernia. One artery only may be involved, viz., the obturator. The obturator artery, which is commonly a branch of the internal iliac, is occasionally produced from the epigastric, and when so produced, almost invariably descends from its origin so closely on the inner side of the femoral vein, as to lie on the outer side of the neck of the hernial sac, and as we divide the stricture on the inner side, it is free from danger. But if the epigastric travel any considerable part of its course inwards, before the obturator arise from it, the latter vessel is brought nearer to the mesial line, and may descend on the *inner side* of the hernia, instead of the outer. Under such circumstances it is liable to, and indeed is almost certain of, division, in dividing the stricture.

Case.

Rare as these concurrent circumstances necessarily are, I was so unfortunate as to be required to operate some years ago in such a case. A gush of blood followed the division of Gimbernat's ligament, which induced me immediately to exclaim, that I had divided the obturator artery. I succeeded in tying the lower end of the vessel, but failed to reach the upper. The bleeding continued slightly for some hours, and then ceased. On the third day the woman, apparently full of life and strength, was progressing well and promisingly; indeed I had no reasonable cause to doubt her recovery. Twenty-four hours having elapsed without action on the bowels, a very reflecting dresser, in my absence, ordered her four grains of calomel and ten of colocynth. Under the influence of this very appropriate agent, the woman sustained an attack of diarrhœa, and died on the sixth day.

In the attempt to reduce a femoral hernia, we must always keep in mind the situation of the ring, which lies at the inner and upper part of the tumour, towards which it should be drawn. Some benefit is derived in the endeavour to return the hernia before operating, from the position of the thigh, which should be raised and rotated inwards, in order to relax, as much as possible, the fascial structures involved in the formation of the opening through which the intestine has descended.

Cause of peculiar form of tumour.

The peculiar form which characterises a femoral hernia has been referred to the close adhesion of the fascia of the thigh. Some have attributed it to the direction given to the tumour by the lesser falciform process of the fascia lata, which has always appeared irrational enough. It appears to me that the feature is best explained by the necessary angle at which the thigh is brought in the act of sitting, during which the hernia is forced upwards, towards, and sometimes over, Poupart's ligament.

Line of incision.

*Operation for Femoral Hernia.*—The upper part of the thigh should, if necessary, be shaved. The line of the first incision is regulated by the intention of the operator with regard to the division of the sac. If he proposes to leave the sac intact, his incision will hold reference to the region of the femoral ring only, but if otherwise he will be regulated by the necessity of obtaining an entire command over both the protruded parts, which lie more or less in a transverse direction, and the femoral ring through which these parts are to be returned. A longitudinal incision would hardly command the tumour, or a transverse one, the femoral ring; and yet the line is not necessarily made midway between them, but should always hold a closer relation to the ring than to the tumour, because the difficulties of the operation lie rather with the former. I do not see the necessity of a second incision at right angles, even supposing a division of the sac to be contemplated, because there is no advantage gained by cutting on to the tumour, the contents of which, when exposed, may be drawn inwards in a line with the ring.

The dissection is carried down to the neck of the sac, as in inguinal hernia, and every effort made to remove by dissection the cause of the strangulation. The seat of the stricture can always be ascertained by pressing the hernial tumour upwards towards the abdomen, and placing the finger on the point of resistance, as recommended by Mr. Luke, than whom no surgeon has done more to simplify the operation for hernia. If requisite, the sac should be divided, as before described, either by pinching it up with a pair of fine forceps, or by raising a point of it with the tenaculum. The tension of the ring is usually greater than in inguinal hernia, unless the latter be of recent occurrence. Often the nail alone can pass through it. The director being introduced, the stricture should be divided *inwards* or *upwards* and *inwards*. The relief to the stricture afforded by the division of Gimbernat's ligament horizontally inwards, cannot extend beyond about one-third of an inch. If, therefore, the tumour be larger than usual, it is better to make the division of Poupart's ligament, upwards and inwards, because in that direction it may be prolonged, if necessary; or, having divided Gimbernat's ligament, that upwards and inwards may be supperadded. Ever since the operation in which I divided the obturator artery, I have invariably employed a blunt knife for the division of the stricture in femoral hernia, sufficiently sharp to cut the ligament by the aid of some pressure, but which pressure is likely to push the artery before it, should the vessel happen to occupy the irregular position in question.

Division of stricture.

Blunt knife.

## UMBILICAL HERNIA.

In this form of hernia the intestine escapes from the abdomen, either through the original foramen, formed by the entrance of the umbilical cord, or through a fissure close adjoining to it. Placed in the centre of the great anterior wall of the abdomen, with which the large mass of the intestines is in immediate relation, and the muscular pressure on which is more direct than in any other form of hernia, this hernia assumes occasionally an enormous magnitude, including in the protrusion nearly half of the small intestine. The opening or neck is in the linea alba, and is fibrous in texture. Generally the thin, though dense integument covering the navel, is elongated, or expanded over the surface of the tumour; and this integument, lined by a polished surface within, constitutes the sole covering of the protuded intestine. Unlike other kinds of hernia, the umbilical form has no separate sac, for the peritoneum being compressed against the integuments, without the intervention of either fascia or fat, becomes closely adherent to it, and gives it the polished appearance I have alluded to. This polished membrane is a prolongation from, and continuous with the peritoneum. Consequent on the large size, and the comparative rapidity of its increase, the integuments yield irregularly to the influence of the expulsive force from within, and the entire cavity is often separated in large and capacious sacculi, communicating with each other in the centre. Each of these sacculi is filled with intestine. Such, at least, is the condition of the larger forms of umbilical hernia. There is more danger attached to umbilical than to either of the other forms I have described; probably because the operation is nearer the centre of the circulation, and deals with larger masses of intestine.

No distinct sac.

Sacculi.

*Operation for Umbilical Hernia.* The operation for umbilical hernia, in description, is very simple. A longitudinal incision should be carefully made in the upper or lower surface of the tumour, of a length proportioned to its size. There is no reason for making it excessive, yet it should be of sufficient length to command the contents of the tumour. When the cavity is exposed, portions of the intestine may be drawn from the sacculi, and the finger passed down to the neck, and through it into the abdomen. The neck should be bared of intestine at the upper or lower part of the circle: the opening will be found sufficiently capacious to render the resort to the director quite unnecessary. Indeed, the finger is always to be preferred, if it can be introduced with ease and safety. The neck should be divided to the extent of half or three-quarters of an inch, or it may be divided both above and below. It is always better to make this division in the linea alba, because there is no reason why

Finger always preferable to director.

the recti muscles should be involved. In returning the intestine, if any difficulty be experienced, the abdominal muscles may be raised by introducing the finger through the opening, and drawing them upwards, so as, in fact, to enlarge the cavity into which the intestine is to be returned. By such means the intestine will often be replaced without much manipulation, or loss of time. No vessels are involved in this operation, which is almost bloodless. The greatest care is required in applying an efficient compress, after the wound is brought together by suture. A firm pledget of lint, corresponding to the size of the opening through the linea alba, should be placed over the ring; and a second, somewhat larger, applied upon it; and a third, or even a fourth, if the patient be very fat. These pads are buried below the level of the fatty parietes of the abdomen, and may yet require a mass of cotton-wool, or the substance of one or two towels, to complete the requisite mass for pressure. A flannel roller should be carried repeatedly round the abdomen, fixing the immediate agent of pressure in its position, or this end may either be obtained by the application of very broad and long strips of adhesive plaster, or by the hernial truss which has been previously worn, provided it prove efficient to the purpose.

Compress.

The after treatment in either femoral or umbilical presents no peculiar features distinct from other forms of hernia. In all probability, general tenderness of the entire cavity will be more manifest after this operation than after the operation for hernia of the inguinal or femoral rings; but this tenderness must be distinguished from advancing inflammation, and it *will* be distinguished by all observing surgeons.

Three fundamental errors in treatment of strangulated hernia characterised the old school of surgery, and the evils of which are only now waning under the influence of more enlightened knowledge of the human economy. The first of these consisted in the undue postponement of the operation for its relief. Does this practice infer an unjustifiable confidence in the remedial agents resorted to before the operation, or a well-grounded fear of the result after it? Of the two causes, the latter would appear the more reasonable. The old surgeons might

Protracted operations.

well entertain a very reasonable fear of the result of their cases, when so many hours or even days were allowed to elapse, under strangulation, by so highly organised and so sensitive a structure as the small intestine. To meet this evil, the operation should be executed with all reasonable speed, limiting the remedies employed prior to the operation to a few only of the most influential, and acting on the acknowledged principle of the golden rule, that an operation for strangulated hernia increases in danger as every hour elapses. The first agent is the hand employed in the endeavour to replace the intestine; the second, the full employment of chloroform, followed by a repetition of the manual attempt to press the contents of the sac beyond the stricture. As a general rule, and with urgent symptoms, the endeavour to avert the operation should be restricted to the application of these two agents.

Violence of pressure.

The second cause of mortality consists in the violence done to the intestine by the ineffectual attempts to return it, and it is marvellous to hear a surgeon of the high and deserved renown of Sir A. Cooper advising the application of the taxis for a period of half an hour at one time. I have myself seen many hundreds of cases of strangulated hernia, and except in most rare and accidental examples, I have never seen success attend a longer-continued effort than a very few minutes. In this respect the mischief that is perpetrated under the prostituted name of medical science is frightful to contemplate. I have seen the severest forms of inflammation—ecchymoses, effusions of blood, and abrasions of surface, the presence of which could only be referred to the long persistence in this most dangerous, and most inefficacious agent.

Immoderate depletion.

Thirdly, the resort to immoderate depletion after the operation, marks the practitioners as deficient in the possession of a true medical philosophy. Because blood is found in excess, therefore reduce its quantity and you restore the parts to their pristine condition of health. If such be the standard of our knowledge, the public has yet much to suffer and the profession much to learn. Inflammation is an effect, and not a cause! We deplete moderately, in the hope of obviating its consequences; but having depleted, it is better to contend against relapse by the administration of a stimulant, than to resort to further depletion.

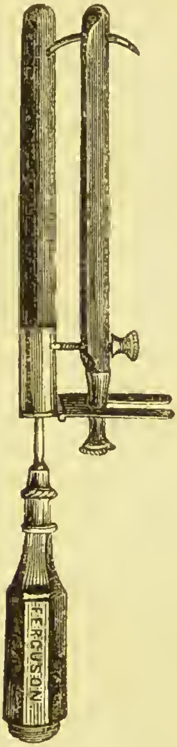
After the operation for strangulated hernia, the patient is by no means exempt from liability to a return of the disease. Here and there we meet with a case in which the disease is radically cured by the operation, but it is rare. Divers plans have been suggested by which to obliterate the opening through the walls of the abdomen. It has been proposed to leave a piece of omentum to occupy the ring, and also by others to effect the same object by its entire removal, to dissect off the sac, to notch the ring, to pass a ligature around the sac, by which it is to be firmly tied below the neck. The old surgeons used to commence this operation by castration! But the truth is, that the operation itself involves all the care and attention of the surgeon at the time. The return of the disease is so slight a consideration, when compared with the serious evil which rouses all the anxiety of the surgeon, that it is not surprising so little has been effected, to say nothing of the difficulty at all times experienced in supplying the place of deficient material. When the ring is large, the difficulty of filling it up by the application of internal agency appears almost insuperable, and the attempt to do so will but aggravate the danger.

**Means resorted to, to prevent return.**

## RADICAL CURE OF HERNIA.

It cannot be denied that the radical cure of hernia is a great object in surgery, and various have been the suggestions made for its accomplishment. But the success has not been commensurate with the ingenuity displayed in the attempt to obliterate permanently the dilated opening through which the intestine has escaped.

An operation has been recommended and adopted by Professor Wurtzer, that has obtained some considerable success in its application to cases of inguinal hernia; but the principle of which is inapplicable to the varieties of femoral or umbilical, or even of either form of inguinal hernia, when of long standing. Obliteration of the opening is effected by the union of the opposite sides of the canal through which the hernia protrudes. One condition would appear to be indispensable, viz., a canal, and not a mere opening. This it is that constitutes the difference between recent and old oblique inguinal hernia. Two *surfaces* must be made to adhere, either to each other or to some intervening substance. The substance employed for this purpose in Wurtzer's operation is the scrotum, a portion of which is pushed up into the canal and retained there till it becomes adherent.



Operation.

For this purpose a wooden plug is employed, somewhat conical in form, the extremity of which is carried up into the canal through the external ring, pushing before it a portion of the scrotum. Prior to the introduction of the plug, the parts should be well examined by the operator, the finger introduced into the ring, and the spermatic cord drawn towards the upper part of the canal to protect it from injury. Within the wooden plug is a metallic spring, terminating in an eyed needle, of about three-fourths of an inch in length. Having reached the point to which the plug can be passed in the canal, the needle is forced outwards through the anterior wall of the canal and integuments, and pressure is made on the front of the groin by means of a flat piece of wood, through a hole in which passes the needle, and to which it is fixed. By means of a screw in the plug, the needle may be partially withdrawn, and thus the pressure may be regulated.

Many of these operations have proved successful preventives to the return of hernia, but success is by no means invariable. On the whole, inasmuch as the operation itself is neither painful nor dangerous, is attended by no other evil beyond that of a few weeks' confinement to bed, it may be recommended for adoption in such cases of inguinal hernia as above alluded to. On such conditions the frequency of failure by the return of hernia, is to be scarcely deemed an objection fatal to the experiment. Ample time should be allowed for firm union of the opposite surfaces, and a hernia truss, effecting diffused and general pressure over the canal, should be worn for some months. Mr. Coote of St. Bartholomew's has performed this operation on many occasions, and with a considerable amount of success; but it must be acknowledged that it has not yet received the approval of the entire profession. To Mr. Spencer Wells undoubtedly belongs the merit of having introduced this operation to the profession in England, and the favourable reception it has hitherto met with is mainly due to the success with which he and some others following him have practised it. For a more detailed description of this operation, I may refer to what he has written on the subject in the *Medical Times and Gazette.*

## CHAPTER XXIII.

## OPERATIONS ON THE EXTERNAL ORGANS OF GENERATION IN THE MALE.

---

### PHYMOSIS.

Retraction essential to health.

THIS operation is required either in consequence of disease, or of congenital deformity. A congenital contraction of the prepuce is not uncommon. The exposure of the surface of the glans is somewhat essential to health and to cleanliness. The secretions of the small glands in this region are liable to become morbid, and the evil resulting from inability to expose the affected surface is often great. It is very possible that the constriction of the prepuce might be overcome by persevering art, without the aid of the knife; but the process would be tedious and unsatisfactory, and, as a far less troublesome and more conclusive measure, we resort to a division of the constricted portion.

Structure.

The prepuce is composed, as is well known, of an external layer of skin, and an internal layer of modified mucous membrane, with cellular tissue inclosed between them. The abnormal contraction is seated almost exclusively in the inner, for the outer layer or skin is distensible in a far greater degree than the mucous membrane, with its cuticular lining. The art of the operator consists in dividing as large a portion of the one, and as little of the other as possible, and it is at the same time a desideratum not to leave the glans entirely denuded. To meet this indication with nicety is not easy, by the operation commonly adopted. If an incision be made longitudinally through the entire prepuce, little benefit will be ultimately gained, for the wound will reunite as before, and it is often deemed necessary to remove the offending portion altogether.

Operation.

With this object the surgeon, pinching up the exposed edge of the foreskin with his finger and thumb, places it between the blades of an instrument used for this purpose, by which it is fixed and firmly held. The bistoury is now employed to separate all the membrane projecting beyond the blades. The outer skin then retracts considerably, leaving a largely exposed and bleeding surface. A director is then introduced on the upper surface, underneath the remaining layer, nearly as high as the corona glandis, which is divided by the bistoury. The angles left by the last incision are simply turned backwards, and the operation is completed. Wet lint may be placed around the penis, and the patient should remain quiet for some days. If too small a portion of the prepuce be removed, the evil will return by the process of cicatrization. It is the custom of some operators to unite the two flaps, formed by dividing the mucous membrane, to the edge of the retracted skin, but it is not necessary to do so.

Improved operation.

A better mode of performing this operation, and by which a larger portion of skin is retained, consists in dividing the mucous membrane alone. If the integument be of excessive length, however, a small portion should be removed circularly, as in the former operation. This may be done without the aid of the forceps, by a strong pair of scissors. The operator then, introducing a pointed bistoury on a director, divides the mucous membrane from within outwards, immediately underneath the integument, beginning as high as the corona. The sufficiency of this division is determined by the facility with which the divided prepuce is passed backwards over the glans. In the majority of cases, it is unnecessary to remove any portion of the external skin, and the operation then consists only in the straight, but entire, division of the mucous and cellular tissues from within outwards. The prepuce is drawn tightly forwards, and a director is introduced as far as possible on the upper surface; the bistoury, sharp-pointed, should be drawn slowly forwards, dividing every texture but the outer integument. For this great improvement on the old operation, the profession is indebted to Mr. Savory, of St. Bartholomew's Hospital.

## PARAPHYMOSIS.

This condition of the prepuce rarely requires the aid of the knife. When the foreskin is retracted behind the glans, under inflammation of any kind affecting this region, it may become swollen by infiltration of serum, more or less albuminous in character, while the permanent constriction around the glans increases the evil, by arresting the circulation through that structure, and if the mischief be neglected when the constriction is great, sloughing of a greater or less portion of the glans will, in all probability, ensue. The natural relation of these parts must be re-established, but this is very often a matter of considerable difficulty, requiring abundant patience and perseverance in its performance. While the thumbs are employed to press out the blood from the distended glans, and to lessen its bulk, an attempt is made with the fore and middle fingers of each hand to drag the prepuce forwards.

Sloughing.

General pressure.

Sometimes it is necessary to proceed even more systematically to elongate the penis, and to grasp it in the entire hand, including in the general pressure the œdematous foreskin. This pressure should be continued uninterruptedly for ten minutes or more, and then the glans should be pressed backwards in the centre, or at the orifice of the urethra; the general integuments of the organ being at the same time drawn forwards with some force.

It may be necessary, in certain cases, to divide the constriction behind the glans, before we can succeed in reducing the paraphymosis. This constriction is generally deeply seated, between two folds of the prepuce. Sometimes the extremity of the prepuce becomes so œdematous, that a partial evacuation of the fluid by means of a grooved needle is necessary, in order to accomplish the reduction.

The above rules of treatment are applicable to cases in which the constriction is so great as to demand immediate relief. The majority of ordinary cases of paraphymosis may be safely left to the remedial influence of a poultice and a purgative.

## HYDROCELE.

Causes.

Common hydrocele, or water in the tunica vaginalis, is generally the product either of chronic inflammation of the testicle, or of exercise in excess. Occasionally, indeed, it is not attributable to any apparent cause. When the symptoms which characterise it are well marked, the disease is easily distinguished from any other form simulating it, but its true character is not always clearly ascertained without some trouble.

Symptoms.

Hydrocele commences below, whereas hernia, with which it is most likely to be confounded, descends from above. The swelling of hydrocele is generally larger below, and somewhat pyriform; hernia is irregular, and often larger above. In hydrocele the ring is unaffected as regards size; in hernia it is largely dilated. In hydrocele the tumour is translucent, on placing a light behind it, or on looking down a tube of paper brought into contact with it against the light. The testicle cannot be felt, because it is within the tumour and forms a part of it, by reason of the relation between the tunica vaginalis and the testicle. In hernia, the testicle can generally be distinctly felt. Hydrocele is unvarying in size, but slow and uninterrupted in its progress; hernia is irregular, and influenced by position. We have impulse in coughing in hernia, unless when tightly strangulated, none in hydrocele. Hydrocele is uniform and elastic on pressure; hernia partially elastic and doughy. Each disease has a history pertinent to itself, of origin and progress.

Chronic hydrocele.

Simple hydrocele is easily detectable in its early or middle stages; but when the disease is very chronic, the sac becomes hard, thick, and incompressible; it encroaches on the ring, and loses its translucency. It is then that our powers of diagnosis are called into requisition, and the nature of the disease must be established beyond doubt, because the treatment is critical; a puncture relieves the one, and possibly destroys life in the other case.

When the nature of the disease is not very distinct on a first examination, the scrotum should be drawn down, and the fluid pressed to the bottom of the cavity. This may be done by a gradual process, by which the membranes are distended, or rather elongated. The sac is thus rendered tense, and by being grasped in the hand the nature of the disease is rendered more apparent.

In hydrocele, the testicle is fixed to the back part of the sac, and consequently we puncture in front, directing the trocar from below, obliquely upwards and backwards. This removal of the fluid by puncture, is the palliative or temporary treatment. The permanent treatment consists in altering the condition of the sac, and by that means arresting its power of secretion. This object is usually attained by injecting port wine, diluted with water, into the sac, of which the quantity injected is usually sufficient to distend the sac. Care must be taken to keep the canula from slipping out of the tunica vaginalis. The consequence of this application is an attack of orchitis, which is often exceedingly painful and protracted. Sloughing of the scrotum, and even death have been recorded as its occasional consequences.

Injection of port wine.

This disease merits a milder treatment, for the cure is greatly disproportioned in its severity to the disease itself. The acupuncture affords relief for a time, but does not commonly possess the merit of a radical cure. If repeated, it is occasionally successful. A very efficient treatment is that of the injection of the simple tincture of iodine, in the proportion of one dram to three drams of water, as recommended and adopted in India on so large a scale by my friend Mr. Martin, who has tried various proportions of the stimulating fluid, and has found by practical inquiry, and on a scale of enormous extent, that the above is the exact proportion, combining safety with the requisite stimulus to arrest secretion. Half an ounce of this compound is injected, retained, and absorbed. My colleague, Mr. Lloyd of St. Bartholomew's, relies on the introduction through the canula of a minute quantity of red precipitate of mercury, which he conveys into the sac by means of a greased probe. The end of the probe having entered the sac, the canula may be withdrawn, and the powder retained by pressing together the sides of the sac in the act of withdrawing the probe.

Injection of iodine.

I have treated several hydroceles which had resisted stimuli by means of a thread passed through the sac—which is, however, not very tolerant of violence. If much irritation follows, the thread must be immediately withdrawn. Should the disease yet return, the sac of the tunica vaginalis may be laid open with a pointed bistoury.

## HYDROCELE OF THE SPERMATIC CORD, OR ENCYSTED HYDROCELE.

Under these terms is expressed a disease, consisting of a sac containing a pale serous fluid, connected with, or formed in, the male spermatic cord; but it is also found, though rarely, on the round ligament of the uterus in the female. In both examples it occupies the region of the groin; and, inasmuch as it exhibits some features not very dissimilar from such as are presented in inguinal hernia when confined to the groin, and with which it has not infrequently been confounded, it is incumbent on the young surgeon to examine it carefully before pronouncing judgment. It is a disease more common to boyhood than to more advanced age.

The sac of encysted hydrocele is formed by the cellular structure of the cord itself—the tissue which forms the band of connection of the various parts that compose it—and it usually occupies that part of the cord which emerges from the external abdominal ring. Its usual size varies from that of a marble to a walnut; but I have seen it considerably larger. It is of more frequent occurrence in the male than in the female, because the loose cellular tissue of the spermatic cord is more abundant. It is also muscular, and therefore subject to motion; and motion combined with pressure under local irritation, is the nearest approach we can make in the direction of cause. It is distinguishable from hernia, 1st, By its immobility being always stationary, both as regards locality and size. 2ndly, The tumour was born on the spot it occupies, and we find no distension of the inguinal canal causing the fullness presented in cases of oblique hernia. 3rdly, It forms a part and parcel of, and is identified with, the cord, and will move with it, if the cord be elongated by being drawn downwards. 4thly, Encysted hydrocele is usually rounded in form. 5thly, The date of its origin is obscure, its growth having originated gradually from the first deposit of fluid in its adventitious sac. 6thly, It is unattended by either pain or a sense of distension. 7thly, Although it is difficult to obtain evidence of fluctuation, yet the sensation conveyed is that of fluid.

In direct hernia, which it more nearly resembles, the swelling is placed on the inner side of the cord, and does not follow its movements. Encysted hydrocele is placed upon the cord, and is therefore in front of it. Any attempt to press the tumour upwards into the canal will fail. When unusually large, its translucency may be made manifest by selecting a suitable position of the patient for the experiment.

Encysted hydrocele is not very tenacious of life, and will yield to suitable remedies. The simplest, and often the most efficient agent, is local depletion. I have cured many by the application of two or three leeches. The contents may be evacuated by means of a fine trocar, and the sac injected with the diluted tincture of iodine, employed in hydrocele of the tunica vaginalis. Should these measures fail, the sac may be laid open and filled with lint, cotton, wool, or charpie. To open the sac by elaborate dissection with a view to its removal, is most unnecessary.

## HEMATOCELE.

Symptoms.

This name is given to a collection of blood in the tunica vaginalis. The history and symptoms are the following. A tumour more firm, and less elastic, than hydrocele; impervious to light; occurring suddenly, or within a few hours, of any accidental blow or other form of violence; also occasionally following the operation of puncture for hydrocele; and when met with in hospital practice, often dated back to injury of some years' date; unchangeable in size or dimensions; heavy to the hand supporting it, and unattended by pain. The introduction of a minute trocar produces bloody serum in small quantity.

There is no alternative to laying open the tunica vaginalis freely. Warm water should be injected freely, in old cases to detach the broken down fibrin, which is adherent to the sac. Care must be taken to keep the wound open until the cavity is free; hence the necessity of a *free incision.* I have known the testicle removed on more than one occasion in hematocele, under the supposition that the organ was the seat of disease. I mention the fact as a specimen of surgery worthy, scarcely worthy, the commencement of the early part of the last century. I dissected one case, and found the vas deferens obliterated.

In the course of last year a case presented at St. Bartholomew's Hospital, apparently of enlarged testicle, which had reached a considerable size. The disease had acquired its magnitude by gradual increase of many months. It possessed all the attributes of malignant growth, so steady was its enlargement. It resisted every form of treatment local and constitutional. Before tying the cord, and in obedience to an imperative law in surgery, I made a free incision into the tumour, which proved to consist of healthy blood oozing from the tunica vaginalis.

We have sometimes to contend against complications of hematocele with inguinal hernia, by which the diagnosis becomes difficult and obscure. I mention the following case among others that I have seen :—A man was admitted into one of my wards with a very large tumour of the scrotum. The mass of the disease was clearly that of the testicle or its membranes, but more remained behind. The inguinal canal was large, and I detected a hernia descending into the upper part of the scrotum. The hernia was reducible, but returned immediately on the removal of the hand. In the course of a few days I punctured the tumour at the lower part, and let out a few drams of bloody serum. Inflammation of the tunica vaginalis, no uncommon occurrence, followed. The scrotum became greatly swollen and painful, and the man himself was very ill with irritative fever. Having returned the hernia into the abdomen, as fully as I was able, for manipulation had now become difficult, I made a free puncture into the lower part of the scrotum, and a rush of fœtid air escaped, and continued to flow for many seconds from the wound. The impression around was that the intestine had been punctured. This gas was of course evolved in the tunica vaginalis by the process of decomposition of its contents consequent and caused by the puncture. Having laid open the sac freely, I filled it with lint. The man's recovery from the hematocele was complete, and the hernia was so greatly reduced that an ordinary truss was sufficient for its retention within the abdomen.

Hydro-hematocele.

Mixed cases occur to which the name of hydro-hematocele is given. The addition of blood probably indicates more violent action than usually attends cases of hydrocele; they are, however, amenable to the same treatment as that disease.

## CASTRATION.

Castration is a rare operation. It owes its infrequency to the adoption of improved principles of surgery. Castration is only justifiable in cases of disease of the testicle, whose justly-suspected malignancy leaves no hope of its restoration to health. When malignant disease, of which encephaloid cancer is perhaps the most frequent variety to which the organ is liable, affects the testicle, the operation is still contra-indicated, if the disease be far advanced; and especially so when the lumbar and iliac glands are extensively implicated, the presence of which may be ascertained on pressure in the iliac fossa. Under such circumstances, we do but promote the extension of the morbid actions, by resorting to operations, and stir up a more vigorous action, in the place of that which was comparatively dormant. The operation for castration is very simple. The patient being placed upon the table, a free incision is first made into the suspected tumour of two, three, or more inches long, or indeed of sufficient length to expose the interior, and its nature ascertained. If malignant, the diagnosis is confirmed and the operation proceeds by an incision, of from one to two inches in length, made along the spermatic cord, commencing above, immediately below the external ring. The cord is dissected out, and secured between the finger and thumb of the left hand, before it is divided across. This is done to prevent its retraction into the canal before

Malignant disease does not always warrant it.

the spermatic artery is tied. The epidydimic branch, if produced so high from the trunk, should be tied also, and the cord then be permitted to retract. When this part of the operation is completed, the scrotum and its membranes are laid open, and the testicle rapidly dissected out, care being taken to avoid the septum scroti, by which the other testicle would be exposed. The wound should be united by sutures and bound up in cotton-wool.

## ON THE INTRODUCTION OF THE CATHETER.

Description inadequate.

It is impossible to teach the introduction of the catheter through the medium of words, or to convey the impressions made in the operation, by any description, however correct and however elaborate. The actual and repeated contact of the instrument with the living urethra is the only foundation on which skill can be built, and confidence acquired. Description may lead to the prevention of injury, but as there is no royal road to experience, so the most perfect description can but facilitate a skilful manipulation. It may point out difficulties, but cannot supersede them. And so far description may be useful in reference to the subject of catheterism.

Among the operations in surgery, not one marks the dexterous surgeon more pre-eminently than that in which an instrument is passed freely and without pain into the bladder; while, on the other hand, considering dexterity of manipulation as the exception, and the want of it, the rule, if we take the entire body of the profession as the field of observation, there is perhaps no operation in the whole range of surgery, the negligent performance of which is the source of more abundant evil than this.

Force objectionable.

In the introduction of instruments into the bladder *force* is rarely justifiable; but it may be asked, what is force? how can we determine the degree to be employed without injury to the structure of the canal? because what is called force by one man, another would employ in mistaken security. As a general rule, *the instrument should take its own direction, and pass into the bladder with little more than its own weight.* But this direction ought to be dictated by the natural curve of the urethra. From the moment we begin to employ force, we are striving to adapt the urethra to the false movements of the catheter, and hence injury by rupture of the membrane.

The natural curve of the urethra is much less in degree than that of the instruments generally employed. Still there is a curve, and the catheter should be adapted to it; in passing a straight instrument into the bladder we do violence to the form of the canal. This curve is placed at the junction of the pelvic portion of the urethra, with the external or perineal; that is to say, low down in the perineum. The functions of the penis and the position of the bladder combine to render this curve a form of necessity. The unpractised surgeon should always bear in mind that the lower surface of the canal is extensible in its structure, while the upper surface is firm and far less yielding, and hence the greater frequency of injury to the lower than the upper. The point at which the urethra enters the pelvis, in passing through the triangular ligament, is very low down and close to the rectum. The common fault in young operators is founded on miscalculation of this fact. Sufficient allowance is not made for the depth of the symphisis pubis from above downwards. The point of the instrument should be carried down nearly to the bottom of the perineum before it is turned upwards into the bladder. The first and common error is caused by the attempt to depress the handle of the catheter before it has reached what I may term the angle of the canal. The point is thus pushed against the triangular ligament, above the urethra, or even against the bone. In endeavouring to avoid this evil we fall into the opposite, and the result is rupture below or at the side. The success of one man over another is less due to his dexterity of hand than to his obedienece to the rule that teaches us, while introducing an instrument along a healthy urethra, *to avoid resistance.* In a healthy urethra it is easier to pass a moderately large than a small catheter, because the large instrument distends and opens the canal more fully as it passes, whereas a small instrument is liable to push the membrane before it into a fold, not to catch in the lacunæ, which is impossible. In introducing the catheter, either the upright or the semi-recumbent position is

A common error.

most favourable. If in the upright, the patient should stand at the distance of some inches from the wall, and lean backwards against it. The penis should be grasped between the thumb and index finger of the left hand, about half way down the organ, and a catheter of a moderate size introduced.

Whether the convexity of the instrument be directed to the abdomen, or *vice versâ*, is of no moment. The advantage of this position arises from the fact of its giving a greater facility for carrying the point down into the perineum, before the instrument is turned. But the same end may be obtained when holding the catheter with a large curve, with its concavity towards the abdomen, provided the handle of the instrument be kept close to the left groin, in the hollow of which it may almost be said to lie; while, if an instrument be used with a slight curve, the handle should be kept at an increasing distance from the abdomen. If the first position be adopted, the catheter having reached the bottom of the perineum, must be turned round in a half circle, to bring the concavity upwards towards the abdomen; and this movement is not always safe, because the point, unless the instrument be held very steadily, will revolve in a small circle, instead of turning on its own axis. The difference, in fact, between the two modes, consists in this; that in that first described, the operation is divided into two stages, each corresponding with the two directions of the canal; while, in the second, the curve of the urethra being lessened by the act of extending the penis forwards, the instrument passes along it by one continuous movement into the bladder. In the act of introducing the instrument into the orifice of the canal, the handle should lie across the left thigh, and then, being raised a little towards the groin, passed down into the perineum, and may still be continued in this oblique position, almost until it enters the bladder, when it will naturally assume the mesial line. This rule will always vary according to the curve employed. In a healthy urethra a degree of pressure equal to the weight of a few ounces, is sufficient to effect the required object.

Large and small curve.

Two stages.

## ON THE INTRODUCTION OF INSTRUMENTS EMPLOYED IN THE TREATMENT OF STRICTURE.

Pathology of stricture.

It is a common but erroneous creed held by the junior members of our profession, that there exist two forms of stricture of the urethra, permanent and spasmodic, whereas we rarely find the two forms of contraction of the canal otherwise than combined. It is true that in persons of an irritable habit, retention of urine will occasionally follow an attack of gonorrhea, or under any circumstances of unusual dissipation, but this does not constitute stricture, inasmuch as the evil passes off with the cessation of the immediate cause, however severe may be the symptoms during the period of its existence. By the term "spasmodic," as applied to stricture is meant the temporary increase of the evil of permanent stricture caused by the contraction of the muscular fibres of the canal at the part diseased. The permanent disease is the result of positive contraction of the canal, and its immediate cause is found in the deposit of organised lymph in the submucous tissue. The stricture may be complete or incomplete, or it may occupy a greater or less portion of the canal, but it is permanent, in so far as it results from a permanent deposit obstructing the free passage of urine from the bladder. Spasm is a local condition which is inherent in a particular system, and marks a constitution—permanent deposit results from local disease, and is a common sequence of that disease in a greater or less degree in all persons.

Stricture of the urethra is, on account of its slow progress, remarkably insidious in its nature. We may be told by a patient that he passes water freely, when on observing the calibre of the stream we find it reduced to one third its natural size, and on attempting to pass an instrument, the canal rejects the introduction of No. 5 or 6. And the converse of this position is also true. There are members or rather pseudo-members of our profession, who live on the ignorance of the male population, who believe, or who affect to believe, stricture to be all but an universal ailment, and who resort to the use of the bougie, armed with caustic of a destructive kind, on all occasions, pointing to any and every kind of temporary derangement of the urinary passage. This is not credulity but misplaced confidence on the part of the public, mistaken reliance on the supposed honour of members of our high profession, the very name of which is compromised by such devices for obtaining money.

When there exists sufficient ground for the suspicion of stricture, the canal should be examined, not however with a view to cure, or even to relieve, but for the purpose of ascertaining the extent of the disease.

Instruments.

Three kinds of instruments are employed in the treatment of stricture, the metallic, the wax, and the cat-gut bougie. In thoroughly experienced hands the metallic instrument is the most efficient agent of treatment, the wax the safer, the cat-gut being only available in very contracted stricture, through which when passed it is retained, and absorbing the moisture of the canal, it distends the walls by increase of size.

Practice.

A bougie whether composed of metal or wax is passed gently down to the obstruction. If the instrument pass readily to the membranous part of the canal, generally speaking the stricture is not very formidable, and it will yield to steady persistence in its use. If, on the contrary the progress of the bougie is arrested by stricture high up in the canal in which case the symptoms of the disease are usually more severe, we may then anticipate more difficulty in the future progress of the case. In the introduction of the wax bougie, the point may be a little raised at a large angle with the shaft. No. 6 or 7 * may be selected for the first occasion, and while passing along the canal, the penis should be drawn forwards with a view to elongate the membrane of the urethra, and remove any folds that exist. The surgeon thus ascertains the locality of the stricture, the condition of the canal anterior to it, and he judges of the character of the constitution by the amount of pain expressed, and the tendency or otherwise of the person to syncope or rigors. Some persons bear the introduction of a bougie with comparative indifference, others suffer much physical pain, while many faint without any sense of physical suffering. On the first time of introducing a bougie in

---

* It is unfortunate that we have no standard size for instruments. No. 6 of one maker is often as large as No. 8 of another.

the treatment of stricture, which is impervious to the instrument, it should be pressed slightly against the stricture and withdrawn, but on all subsequent occasions the efficacy of the bougie is only obtained by steady pressure against the stricture. A bougie, whether wax or metallic, may be applied against the commencement of the stricture, or if sufficiently small to enter the contraction, it may act at once on the whole of the diseased structure involved, but it rarely happens that the instrument shall be so fortunately selected as to accomplish this result without the operator being enabled to carry it on to the bladder. A bougie probably acts mechanically and also as a stimulant, and in either case great benefit is derived from its judicious application. The judgment is exhibited in the careful application of such force as will effect good without exciting irritation, and in caution against its too frequent application. A full-sized instrument is generally not only the safest, but the most efficient in the treatment. It is desirable to distend the canal, and to press uniformly over the whole surface. If a wax instrument is selected, which is, perhaps in inexperienced hands, preferable for exploring purposes, No. 6 or 7 may be employed. If a metallic instrument is, it should be short in the shaft, and the curve not large, and adapted with a firm handle of wood. I have elsewhere spoken of the great superiority of a short over a long instrument, affording to the operator a clearer idea of the relation of the point. To understand this quality we have only to imagine a metallic catheter or bougie of two feet in length, we can then comprehend the difficulty we should experience in knowing the exact relations of its point.

A bougie should be pressed against the stricture at every operation, and held firmly in contact with it for two or three minutes and withdrawn. An interval of two or three days may elapse between each operation. If bleeding follows, we may generally infer that less than usual benefit, if any, will result, as it is obvious that the instrument has been carried in the wrong direction, and if the bleeding amount to hæmorrhage, two or three weeks should be allowed to elapse before its repetition, and the operation then cautiously resumed, various expedients have been adopted for the removal of obstruc-

Hæmorrhage.

tions from contraction of the canal of the urethra. Caustic potash, lunar caustic, sulphate of copper have been introduced into the point of the bougie, but they are now rarely adopted. Cutting instruments are serviceable in cases of firm gristly stricture in dexterous hands, and after long and repeated experience in the individual case. Among these may be mentioned, the stilette of Mr. Stafford, and a safer instrument employed by Mr. Fergusson, the two very limited cutting edges of which are placed on the instrument at some distance behind the point. In well-selected cases both these instruments are calculated to do good service by removing the obstacle to the introduction of a good sized catheter. But my own experience of Mr. Stafford's stilette, is not favourable to its employment except on very rare occasions.

Mr. Thomas Wakley has invented an ingenious method of rapidly dilating the urethra in severe cases of stricture. It consists in the introduction of another instrument over the first, which is retained as a director after having been passed through the stricture. In this way pressure and dilatation to any extent may be effected. The smallest instrument is first introduced, then a second accurately adapted to it, is passed over it, then a third, if necessary, and so on. Of course such a practice must be regulated by extreme caution.

## ON CATHETERISM IN CASES OF FALSE OPENINGS IN THE URETHRA.

Rupture of the urethra is the frequent product of violence exerted in the attempt to reach the bladder, and, for the most part, presupposes disease of some extent. This disease usually commences, as I believe, at the junction of the bulb with the membranous part of the canal, and as it advances, by time extends backwards as far as the prostate gland, but rarely involves the prostatic portion of the urethra. Such are the results of my own observation. The preparations in the Museum of St. Bartholomew's Hospital afford the same evidence. Mr. H. Smith, after much observation, places the most frequent seat of stricture in front of the bulbous portion. Here resistance is first felt by the operator, by whom it is attempted to be overcome by force, and the result in unskilful hands, is rupture. The instrument passes on the outside of the mucous membrane, and, if still urged forwards, it takes the direction of the cellular structure between the bladder and rectum. It is somewhat remarkable how little irritation is sustained to the constitution by the occurrence of this accident. Blood may escape freely at the time, but the urine flows as before, without benefit from the operation, or serious injury from the accident.

False passage.

In lower surface.

The wounds in the urethra are almost invariably made on the sides, or lower part of the canal, rarely or never above. When the catheter, or other instrument used, has once passed into them, it is very liable to follow that course invariably, unless especially avoided; and to effect this object, the penis should be drawn forwards upon the instrument with some force, great care being taken to keep the point of the catheter pressed against the *upper surface* of the membrane, and to ascertain that the handle occupies the *exact centre*, and passing at right angles to the abdomen. So long as the handle lies straight, the point will occupy the canal. As soon as it leaves the urethra, the handle will slope a little to one side, and the slightest obliquity in the handle marks considerable deviation in the point of the instrument. Moreover, it will be found that the point cannot be made to rotate with any approach to freedom; and especially so in the direction which tends to remove the obliquity, and to restore the instrument to its straight direction.

Obliquity of handle.

Under these circumstances the instrument should be withdrawn, and one, two, or three weeks allowed to elapse. A metallic bougie may, perhaps, be used on the next occasion having a different curve.

If the surgeon has ascertained the nature of the case, he has also learnt the position and the direction of the false opening; and this he should carefully avoid. He may find it convenient to pass the instrument with his left hand, and in all cases of ruptured urethra to use a large instead of a small catheter. All instruments employed in exploring the canal should be *short in the shaft*, and fixed into a firm handle. Little more than two-thirds of the length of the old catheter will suffice for

Short metallic bougie.

the length required. This remark, however, applies rather to the metallic bougie than to the catheter.

**False passage mistaken for stricture.**

I am quite persuaded that we often refer to stricture what should be termed a false passage; cases in which the point of the instrument is obstructed by the triangular ligament. Here the obliquity of the position of the handle in relation to the abdomen, is a frequent attendant on the attempt to reach the bladder. The point is not locked, as though held by a stricture, but remains more or less free; and yet a false passage will occasionally bite the catheter, or hold still more forcibly a wax bougie. Many cases have occurred to me, that appear to justify my opinion as to our liability to err on this subject, the first of which was that of a gentleman under my care for supposed stricture, many years since. I could never succeed in passing an instrument into his bladder; whenever the slightest degree of force was employed, an attack of fever followed. Weeks and months elapsed, and I made no advance. I held consultations with many eminent surgeons, all of whom, equally with myself, failed, but recommended perseverance in the attempt. He had been under my charge for nine months, when, on one occasion, having adopted a shorter metallic bougie than that I had been accustomed to use, suggested to me by Sir B. Brodie, the instrument (No. 7) passed immediately, and without pain or effort, into the bladder, to the astonishment of my patient, and still more of my own. The success was unequivocal; the instrument passed up to the shoulders, and moved freely in all directions within the bladder. This feat I repeated on the following day; and from that date, neither I, or any other man has succeeded in passing an instrument beyond the original place of obstruction.

The second case was that of a Captain A., whom I had treated for stricture, in conjunction with Mr. Wiblin of Southampton, a very excellent surgeon, and thoroughly competent to such cases. Neither he nor I had been able to reach the bladder. The instruments employed by me, whether wax or metal, passed down into the perineum, and then stopped. It had obviously escaped from the canal. Captain A. was daily expecting an appointment abroad, and his continued suffering was not unlikely to mar his prospects in life. His water passed tolerably freely, but he was subject to attacks of spasm, and pain in making water; and these attacks had, by repetition, made some inroads on his general health. I succeeded in passing a large catheter into his bladder on one occasion, retained it there for some forty-eight hours; and from that hour he has had no symptom of disease.

In a word, the rules to be observed are the semi-recumbent position of the patient, the pelvis placed perfectly straight, a catheter firm in the handle, short in the curve, and in size not less than No. 6 or 7, the extremity of which is to be kept in contact with the upper surface of the urethra. As the point enters the perineum the handle should be perfectly straight as regards the trunk, and move with the same facility to either side. Should a well-made effort fail, we may take an instrument with a different curve, and change the position. Under all circumstances the penis should be drawn forcibly forwards on to the catheter in the act of passing the seat of the rupture.

It may appear to some that I have been somewhat too brief in my observations on the introduction of catheters and the treatment of stricture, and that I have passed over in silence many excellent measures which should have been described at length. In truth, the vast extent of this subject, both in its practice and literature, has deterred me. I could not with justice allude to a portion of it only. Therefore I have limited my remarks to a description of the practice which I usually adopt, and which, after some years of experience, I find to be equal to the management of the cases which come before me. Let my silence as to other plans of treatment, the merit of which in particular cases is universally acknowledged, be attributed solely to my inability, in a work like the present one, to do justice to all of them. For the rest, I would refer to Brodie's masterly work, Grosse's elaborate treatise, and Mr. Henry Thompson's recent volumes.

## ON CATHETERISM IN CASES OF ENLARGED PROSTATE.

**Symptoms.**

Retention of urine from enlargement of the prostate gland, may be recognised without the aid of an instrument. It occurs in advancing, or in advanced age.* It is accompanied by frequent and incomplete micturition; the desire continues, but the stream is arrested. This occurs twice, thrice, or yet more frequently, during the night. The frequency of micturition has been increasing for years. This condition of the urinary organs is quite unconnected with a venereal origin. Many persons, when first resorting to surgical aid, have never seen a catheter. The stream of urine is too large to pass in such form of stricture, as is competent to produce retention. The urine is generally ammoniacal, with flakes of a flocculent appearance floating in it.

**Third lobe alone enlarged.**

Enlargement of the gland can be detected on examination by the rectum; but we cannot infer the degree of enlargement of the lobe in the bladder by that of the body of the gland.

**Or vice versâ.**

It often happens that the bulk of the third lobe is much larger in proportion than the body of the gland, or the size of one lateral lobe may exceed that of the other.

In well marked and chronic forms of prostatic enlargement, the bladder is pushed upwards, the ordinary position of the neck of the organ being occupied by the rounded mass of the enlarged gland. Consequent on this change of relation, the urethra appears to have acquired considerable increase of length, and the cavity of the bladder lies beyond the reach of an ordinary instrument. To meet this difficulty a long catheter is employed, termed the prostatic catheter; but, so far as my experience goes, it is not very frequently called into requisition.

**Position.**

In order to pass an instrument to the greatest advantage, in a case of ordinary enlargement, the patient should be got out of bed, and placed either against the wall of his room, or in a sitting posture, on the edge of the bed, leaning back against a chair, turned over and covered with pillows. Many a good manipulator has failed, by attempting the operation on the patient while lying in bed. He should sit perfectly straight, with his legs asunder, as far over the edge of the bed as possible. A good-sized silver catheter may be used, No. 7, 8, or even 9, and passed down to the prostate gland. In order to avoid this obstacle, Mr. Hey advised the employment of a flexible gum catheter, the point of which rises when the wire within it is withdrawn; and he suggests that this expedient be applied to the instrument on entering the bladder, for the purpose of raising its point over the enlarged process of the gland. The idea is ingenious, but rarely practicable; for it will be found that the catheter is too fixed in its position to yield to the influence of the wire while retracting it. By pressing the point of the catheter against the obstacle, having previously convinced ourselves that the instrument is really in contact with it, we shall rarely fail. The pressure should be firm, steady, and increasing. Should simple pressure fail, the finger should be introduced into the rectum, and its point directed upwards to the instrument, against which pressure should be made in the vertical direction. In the course of from two to five minutes, the obstacle will give way, and the catheter enter the bladder. When the contents are evacuated, the instrument may be withdrawn, in the belief that the next introduction will be attended with less difficulty.

---

* Mr. Thompson's carefully collected observations tend to show that this affection is not so usually attendant on old age as it is generally assumed to be.

Persistent pressure.

These symptoms generally, though by no means necessarily, return in the course of time. I have known several examples of years passing without relapse. Permanent benefit may be obtained by the employment of pressure against the enlarged growth. This end may be effected by employing a catheter not less than No. 8 in size, with a round curve, and convex to its extremity, fixed vertically in the bladder, while the patient lies horizontally in bed, by attaching to the shoulders of the instrument the weight of a few ounces, or indeed as much as can be borne without pain. The catheter employed for this purpose should possess a short curve, in order that the convexity of the instrument should rest against the morbid growth.

# CHAPTER XXIV.

## OPERATIONS ON THE MALE PERINEUM, AND ABOUT THE ANUS.

There is no part of the body more fruitful of disease than the region of the male perineum. Common abscess, stricture, causing retention of urine, extravasation of urine, extravasation of blood, with rupture of the urethra, fistula in perineo and in ano, abscess of the prostate gland, cancer scroti, and stone in the bladder—all demand the employment of the knife. Under the head of Lithotomy I have sufficiently described the anatomy of this region to render further reference to that subject unnecessary; I therefore proceed at once to the subject of abscess, which often becomes, in this region, an important disease.

Abscess.

*Perineal abscess* is often connected with a morbid state of the canal of the urethra, but it occurs in younger persons, independently of it. It appears in the form of a rounded hard swelling, occurring anywhere between the bulb and the orifice of the anus, sometimes attended with pain, often by a sense of weight only. Its depth, its duration, and size, will enable us to judge whether it belongs to the class of simple abscess, occurring in the subcutaneous tissue of that region; or whether, being the product of a local irritation caused by disease in the urethra, it involves deeper-seated parts, the urethra itself included. If the former, it will pass through the ordinary stages of abscess after puncture, should that be required; if the latter, the progress of the disease will be slow, and the tumour deeper seated, and we shall obtain evidence of stricture and of instruments having been passed. In the former case, the calibre of the canal is unaffected, and micturition may be natural; in the latter, the canal may be compressed, and the act of micturition difficult.

May be simple or not.

When abscess of the perineum is the result of irritation in the urethra, the product of disease, the sac usually communicates directly with the urethra, and urine will follow the puncture, either immediately or at any subsequent effort at micturition.

I know of no medical agency competent to repress the advance of a suppurating tumour, either in this region, or in any other. The progress onwards, under all circumstances, should be encouraged by the administration of bark, wine, and good diet, and the abscess opened as soon as matter is felt, or believed to exist.

## OPERATION FOR EXTRAVASATION OF URINE.

Cause.

This operation is generally required in advanced life in old cases of urethral disease. The probable cause in such cases is ulceration of the urethra, and the evil is increased by the straining efforts required for the expulsion of the contents of the bladder. It may also occur in persons of younger age, as the consequence of rupture of the urethra from accident. But this case is essentially different from that arising from neglected disease in the canal. There is a good deal of mystery yet unexplained, or at least of uncertainty in the source of this disease, and I am inclined to think that we not infrequently confound the existence of deep-seated abscess with extravasation. In a case of stricture advancing slowly under treatment, the progress of the case is sometimes arrested by an attack of retention of urine, accompanied by symptoms of a typhoid character, hot skin, dry and black tongue, delirium, &c. In such cases the experienced surgeon immediately looks to the perineum as the seat of injury. If the attack be recent, it is possible that the local symptoms of fluctuation may be very obscure, or even imperceptible. But more commonly a slight degree of distension of the perineum, accompanied by more or less tenderness on pressure, confirms his impression of the presence of fluid. In other and more advanced cases, the distension is manifest, indicated by the roundness and prominence of this region.

Difficult diagnosis.

In consequence of the dense nature of the structure termed the perineal fascia, the fluid extends forwards, towards the scrotum and groins. The cellular tissue of the scrotum becomes quickly infiltrated, and the infiltrating fluid advances towards the inguinal region, and thence up the sides of the trunk. Congestion of the vessels of the skin accompanies its progress in every part of the trunk, and in one case which I attended, advanced as high as each axilla. I have repeatedly seen great local distension of perineum, scrotum, and penis, accompanied by retention of urine, and symptoms of typhoid fever called extravasation of urine, in which no evidence was obtainable of injury to the urethra. In all these cases the urethra, indeed, is opened from the perineum by the operator, but I imagine, without fully calculating the necessity for such addition to the operation. The fœtor of the pus discharged on exposing the cavity of the abscess, is sufficiently potent to set at nought any evidence as to the presence of urine; and I think we often take it for granted that urine is present, when the evidence of its presence is inconclusive. When urine is largely infiltrated into the cellular tissue, the character of the disease is apparent and unmistakeable. The extent of the disease is greater, it proceeds more rapidly, the early symptoms are not so severe, the latter symptoms more so. Destruction follows in its train, and death without early relief. Incisions into the scrotum and penis give vent to a fluid, having a distinctly urinous smell, and neither the distension of, nor the fœtor from, the perineum are so great as in abscess.

Urethra not always involved.

In puncturing abscess of the perineum, there is no necessity to pay much respect to the anatomy of the region. A long, sharp-pointed knife may be introduced anywhere near the centre of the perineum, and an incision, from one to two inches, made downwards and outward towards the tuber ischii. The depth of the incision should be regulated by the flow of matter; if the discharge be free, and nothing but fœtid pus escapes, we have done all that is required, as far as relates to the perineum. The penis and scrotum also may require incisions, for if involved in the irritation of abscess, they will swell to a great size. No relief can be obtained equal to that derived from free divisions by the knife.

Puncture.

In cases of infiltration of urine, the incisions must be yet more free and numerous. Cellular tissue cannot survive the contact of urine, and the only chance of its

Free incisions in infiltration.

recovery is by making an outlet for the escape of this irritant, so fatal to its structure wherever it is infiltrated. When the incisions are completed, it is safer, with a view to prevent the extension of the disease, to pass a moderate sized gum catheter into the bladder and to retain it. If this prevention be adopted, I do not see that any advantage will accrue from opening the urethra, and still less so if the instrument pass without difficulty into the bladder, which may be facilitated, if necessary, by introducing the finger into the wound, and directing the catheter along the canal. Wherever it is necessary to make incisions into the cellular tissue, they should be made freely. There is great tendency to prostration, consequent on extravasation of urine, and great danger attends it, unless treated early with the most powerful stimulants.

## OPERATION IN CASES OF STRICTURE.

This operation may be required in cases of obstinate stricture, with or without retention of urine, in false passages, or in cases of ruptured urethra from accident, accompanied also by retention. In old stricture, the subject of much former treatment, the neighbourhood of the canal in the perineum is generally consolidated by old deposition, perceptible on pressure. This hard deposition may pervade the line of the canal for some inches in length. In such cases, the difficulty of passing instruments of a size sufficient to effect good service is often exceedingly difficult, although it may be perfectly true, that the canal is patent for urine passed in a fine stream from the bladder. Probably skill and long perseverance in the use of instruments for dilatation would eventually succeed in overcoming the evil, but the time required may be a serious obstacle to its prosecution. The health or the degree of suffering of the person may preclude the trial, and require the disease to be brought to an early crisis. The operation affords immediate relief, and should be resorted to on the above condition. But at the same time it must be acknowledged, that different degrees of dexterity in the use of the catheter will materially influence this necessity. Experience is indispensable to the just management of the case, a thorough knowledge, not of the particular case under treatment alone, but of

Thickening around the canal.

urethral disease in general, the knowledge of the use of the instrument, the degree of force with which it may be urged, and the direction in which that force may be profitably employed. The only substitute for the experience, thoroughly obtainable by a few only, is to be found in the possession of tact and knowledge of anatomical structure; without these requisites we can form no positive gauge of the necessity of the operation.

**Division of stricture.**

In these chronic forms of disease, it is far better to resort to more active operative means than to persevere in agents, palpably inadequate to permanent relief. If a free incision be made along the track of the diseased and contracted portion of the urethra, and an instrument of good size passed along it into the bladder, the operation is followed by the gradual absorption of the gristly material formed around the urethra; and the canal will retain a calibre sufficiently large to meet all the requirements of health and comfort. In fact, nature will remould the canal in the direction of health. And it is, doubtless, a great operation, because it accomplishes a great end, in the removal of pain, both moral and physical, and the restoration of health. But we must be cautious in our selection of cases. The best cunning of our art is rarely more imperative upon us, than in the undertaking to slit up an old urethra with the purpose of constructing a new one. We possess the power, but let us not abuse it. To justify the operation, it must have no alternative.

Mr. Syme, of Edinburgh, has described this operation with detail and accuracy; and has obtained much and deserved credit for its successful performance in many cases. At the same time, whatever be the merit of Mr. Syme, and none will dispute his claims to the successful cultivation of this department of surgical science, it is only an act of justice to acknowledge that the principle of the so-called perineal section was carried out many years prior to the publication of Mr. Syme's work, by many surgeons of the metropolis. I witnessed it on more than one occasion, when performed by the late Mr. Earle, in St. Bartholomew's Hospital; and Sir Charles Bell not only recommended, but adopted it in the Middlesex. Since the publication of Mr. Syme's work, the operation by section of the urethra, has been of late years largely in the ascendant. How often it may have been resorted to in cases of urethral disease, admitting of simpler treatment, were an unprofitable enquiry as would also be the results of such frequent and possibly not invariably judicious appeal to it. That it is a good operation when judiciously selected cannot be denied, but we may rely on it that perseverance in simpler agents will greatly reduce the apparent necessity of the frequent resort to it, and at the same time accomplish the restoration of a sufficiently healthy canal within a term brief enough to justify the selection of the one principle in lieu of the other.

Operation. Previous to the operation, and indeed in every variety of perineal section, the rectum, and as far as possible the entire of the large intestine, should be cleared of its contents. The patient is fixed in the position required in lithotomy, but as I have stated elsewhere, there is no necessity to draw the extremities into absolute contact, in old age, or whenever contact can only be obtained by a painful effort. A fine staff is passed along the urethra beyond and through the strictured portion, and if feasible, into the bladder, which must be steadily held by an assistant. An incision is made in the mesial line of the perineum to the extent of about two inches. The locality of the incision is, of course, determined by the position of the stricture, which is commonly seated in the perineum; but if placed anteriorly, the external incision must follow it. If the contraction be of unusual length, it is not necessary to make the external incision proportionately long, because the only object of the first incision is, that of exposing the canal, and facilitating its division. When sufficiently exposed by the division of all structures around it, as to enable the surgeon to feel the staff distinctly with his finger, the urethra is opened with a pointed bistoury, passed into the groove, and carried along the entire length of the strictured portion. It is of little moment whether the division of the urethra is made from before backwards, or from behind forwards. Each method has its merits. That of the first, or the anterior puncture, consists in the greater facility of quickly reaching the groove in the staff; that of the second or posterior puncture, that it makes on the whole a cleaner cut, and so far as merit can attach to the quality, it is more striking. It has also the claim founded on the recommendation of Mr. Syme of Edinburgh. But in the selection of a particular method of effecting a given object in operative surgery, we must not lose sight of the important question of facility of accomplishment. Mr. Syme prefers the posterior puncture, and he adopts it ; but it does not follow from this fact that the urethra is opened with a facility behind the stricture equal to that in front of it. In selecting the one or the other mode, we must recollect that we are operating through a diseased texture, that concluding the stricture to be very contracted, the staff must be extremely small, and the groove yet smaller ; that, although the structures around the canal of the urethra afford an index to the nature of the disease, they do not point out its extent—and in order to involve the entire strictured portion of the canal in the division, we have no proof that the puncture is not made beyond the stricture, and we leave the first difficulty to be last removed. It may be said, that in skilful hands the difficulty of reaching the groove of the staff by the posterior puncture is not great. But we have no gauge for difficulty. If operative surgery were limited to the skilful and the experienced, there would be no necessity for laying down rules of management for those who are less skilful and less experienced. To suppose the posterior puncture divested of difficulty, when gauged by the standard of average, and something more than average skill, is an error. The depth of the wound, the solid nature of the material divided, the minute size of the groove in the wire-like staff, all proclaim a difficulty to be if possible avoided. The object of the operation is that of making such a division of the cartilaginous or fibrous structure around the canal as will admit the passage of a full sized instrument into the bladder. But for the difficulty of the mechanism, an instrument, on the principle of the *bistoire cachée*, by which the urethra is freely divided from within, would be preferable in the large majority of cases ; but we possess no rule by which to regulate its action, no certainty that we cut only that structure which requires dividing ; and the result is, the necessity of a wound on the surface of the body, and the exposure of the disease to the sense either of sight or of touch. When the canal is sufficiently opened to admit the passage of a No. 7 or 8 catheter into the bladder, the operation is completed. The catheter, whether metallic or flexible, is fixed in its position, and the plug withdrawn by the patient when required. On the care employed in fixing the instrument in the bladder, much of the comfort and somewhat of the success of the operation may depend. I have known examples of escape of the catheter during the movements of restless sleep, which have proved fatal to early recovery by the inability of the surgeon to restore it to the canal without great trouble. (For the best mode of fixing the catheter, see "Ruptured Urethra.") A gum catheter is less liable to escape from the bladder than a metallic one; because it adapts itself to the natural form of the canal, and on the whole creates less discomfort, and it possesses also the additional advantage of being more readily brought into relation with the urinary vessel. The instrument selected should be a new and sound one, and we may rely on its condition of strength and soundness for a period of from eight to twelve days. When removed it should be replaced by a new catheter, if it has become limp or exhibit the marks of calcareous deposit on that part of the instrument which has occupied the cavity of the bladder. A catheter should be retained in the bladder throughout the entire period of treatment, and the urethra frequently examined subsequent to it.

False passages.

One condition indispensable to the success of the above operation, must be adverted to. It is absolutely essential to success that the incision be made into the groove of the staff, while the instrument occupies the track of the urethra, and nothing beyond it. In chronic cases which have been the subject of much and varied treatment, by means of metallic bougies, catheters, stilettes, caustics, &c., false openings, whether the result of abscess and extravasation, or of mechanical violence, are the almost certain issue. The treatment of such established tracks, whether in the form of canals lying parallel to the membraneous portion of the urethra, or in that of sinuses running out from the urethra in the direction of the perineum, the anus, or the thigh, by the means above described, will inevitably fail unless all the false openings be avoided, and the staff be made to occupy the track of the original canal of the urethra. We may dilate the true urethra, and restore it to comparative health, but we never can ensure the permanent dilatation of a false passage. We find cases of stricture yielding to gradual dilatation by instruments, returning rapidly on their disuse, to an injurious state of contraction. A few weeks, and occasionally a few days, will suffice to undo all that has been done in the right direction, during the previous two or three months. If a catheter be retained in the canal for ten or twenty days or longer, its removal is followed by the same result, and the case returns to its former condition. These are cases of false passages which require the almost daily employment of instruments to maintain their patency, and for which no permanent relief can be given by surgery except by such treatment as will detect the deviation from the natural track, and thereby avoid it. I attended a gentleman, aged twenty-five, who had been treated for supposed stricture, which he assuredly had not, by the introduction of various caustics, to the amount of about twenty-five successive times. The treatment succeeded so far, that it all but closed the canal. Metallic instruments were employed, and a false passage followed quickly. When I saw him, his micturition was frequent, and the stream of urine very small, and life had become a burden. With Stafford's stilette I punctured the stricture, and passed a No. 6 catheter into his bladder, where it was retained for several days. On the third day from that of its removal, the contraction was as complete as before the puncture. I passed the catheter a second time with some effort, and retained it for three weeks. The same result followed its removal. A third attempt to maintain the canal patent, subsequently made, has also failed. It is highly probable that in the person of this unfortunate gentleman, the urethra was almost totally disorganised by the repeated application of escharotics; and no prospect remained to him throughout life but the painful one of wearing an elastic catheter to the end of it.

A gentleman, aged forty, had been under treatment for stricture, during the last twelve years. After passing No. 8 metallic bougie, the urethra contracted so completely in a fortnight as to preclude the introduction of any but the smallest sized instrument. I opened the canal from the perineum, and retained a full sized catheter for a period of two months. On its removal the tendency to contract still existed, and though I have lost sight of the case, I believe this gentleman is still compelled to resort to the frequent introduction of metallic instruments, in order to prevent the most inconvenient degree of contraction of his urethra.

I believe these and similar cases, marked by an uncontrollable tendency to contract—to whatever extent the urethra canal is dilated by instruments—can only be explained on the supposition of a false passage, probably of many years' duration; and which, to whatever extent it may be temporarily enlarged, contracts like any other sinus on the removal of the dilating agent.

Catheter retained.

The most solid deposit around the urethra will yield to the long and persistent action of an instrument fixed in the canal. If, in consequence of local irritation, or positive suffering, it cannot be retained by ordinary treatment, we resort to extraordinary means. Opiates in any reasonable quantity may be resorted to—warm baths, chloroform, suppositories, bella-donna inunction to the perineum. All these remedies, and any other that may be devised by the ingenuity of the surgeon, should have proved inadequate to allay the irritation attendant on the retention of the catheter, before we are justified in appealing to the knife. When they or any reasonable portion of these have failed, we proceed to lay open the urethra by process which is often known under the term "perineal section." But the name is radically a bad one, simply because it fails in expression. Perineal abscess, lithotomy, extravasation of urine, all demand perineal section, and cannot be effected without it. The essence of the operation consists not in the section of the perineum, but in the section of the diseased urethra; for it is quite clear that section of the perineum could afford no relief to the disease. However, the name is of very little moment.

## OPERATION FOR RUPTURED URETHRA.

The perineum is liable to injury from accident, such as violent blows in riding, or in falling across railings or pieces of timber, with the thighs separated. Such accidents are often very dangerous from the amount of injury done.

Cause of retention.

The appearance presented by the perineum is that of great discoloration, and of distension, caused by extravasated blood and urine, extending forwards towards the scrotum, and infiltrated into its tissue. Every attempt at micturition fails from causes not very easy to explain.

The common explanation which refers this difficulty to pressure on the canal of the urethra, by the extravasated blood, is insufficient. It may rather be referred to paralysis of the bladder, caused by the shock, in which volition fails to excite the abdominal muscles to action, for it is through the agency of these muscles of animal life that the organic fibres of the bladder are excited to action. There would appear a local consciousness of mischief, a condition which explains the difficulty of micturition, by referring it to a cause allied to that which occasions constipation in peritonitis or other inflammatory conditions of the abdominal cavity. Under circumstances of unusual violence, the pelvic bones may be split asunder. This fracture may take place by the side of the symphysis, or across the rami. The penis may be rent asunder, or one crus torn from its origin from the ramus. The urethra is usually torn across, and the two ends separated from each other by intervening blood. Every attempt to pass an instrument into the bladder is unsuccessful, and we cut into the perineum.

Varieties of injury.

Whether for the purpose of relieving the bladder, in the case of retention of urine dependent on stricture, or on rupture of the urethra, it is requisite that we expose the canal in the perineum, and pass a gum catheter onwards into the bladder.

Operation.

The patient must be placed, as indeed in all operations on the perineum, in the attitude required for lithotomy.

An incision of about two inches in length should be made in the mesial line, passing deeply into the substance. The operator then dissects more deeply towards the centre of the perineum, but keeping upwards towards the urethra, which lies about three-quarters of an inch below the arch of the pubes. He should now employ a director or a straight piece of gum catheter, with which he endeavours to find the orifice of the canal, and by careful manipulation he will find it sooner or later. The entrance of the catheter is immediately followed by a rush of urine, and the patient is at ease. This is the first part of the operation and the most difficult of execution.

The catheter is now brought out through the wound in the perineum to the extent of several inches, and the point turned backwards, and passed along the remaining part of the canal into the bladder, while the upper portion is partially withdrawn. If the canal has been discovered without difficulty, it may not be necessary to bring the point of the gum or permanent catheter out through the wound; but we may make the attempt to pass it at once into the bladder, guided by the forefinger of the left hand. When the instrument has reached the bladder, the end of the operation is answered, and the rest of the treatment must be left to nature.

The catheter should be fastened in the canal, by means of a strong silk thread tied around it, close to the orifice of the urethra, and the two ends carried backwards. These ends may either be fixed by plaster placed rather loosely around the penis; or may be tied around the root of the penis and scrotum, may be fixed to a bandage applied around the abdomen, or attached to a common suspensory bandage. In the latter case four threads will be required, two passing forwards, and two backwards, attached to the suspensory belt, with a degree of tension sufficiently great to prevent the escape of the catheter from the canal, or even that of the eye of the instrument from the bladder. Before tying it, the catheter should be pushed nearly up to its shoulders into the canal. In the course of a few days the urethra will mould itself upon the instrument, which should be slightly moved in the canal or withdrawn and even changed every four or five days. All that is required by the wound is that it be kept clean. The urine should be allowed to trickle away as it is secreted for some days, and then in the second catheter, a wooden plug may be introduced, and the urine permitted to flow off at the convenience of the patient.

Rupture from violence.

In cases of extreme violence, and accompanied by much extravasation of blood, the finger often passes into a cavity filled with coagula, and the ramus of the pubes may be denuded to the extent of an inch or two of its length. The crus penis may be found separated from the bone, or the bone itself broken. It is desirable to remove the coagulum. This is effected by the finger, and partly by the introduction of small pieces of sponge, which may be employed to wipe out the cavity, and free it from the extravasated blood. A gum catheter should then be passed through the penis from above, and the attempt, as before, made to pass it onwards, aided by the finger in the wound. Every direction, and every curve of the instrument, made by altering the form of the wire, should be tried, but without force. The patient should be desired to make an attempt to pass water, and the escape of a few drops may indicate the situation of the posterior opening of the canal, and thus we may succeed in discovering it. Sometimes, in case of failure in the attempt to micturate, this object may be obtained by pressure of the closed hand on the hypogastric region. Should our efforts fail, the patient should be put into a warm bath, by which, probably, the function will be sufficiently restored to enable us, by pressure and by the aid of a good light, to ascertain the precise locality of the concealed orifice. If the difficulty yet continue, after the expiration of some hours, and the increasing size of the organ warn the surgeon of the necessity of affording relief, we have no alternative but that of puncturing the bladder through the rectum.

## PUNCTURE OF THE BLADDER.

Three operations.

There are three directions through which the bladder is accessible by puncture in cases of retention of urine. The first is that already described, through the perineum. The second is made by puncture through the abdominal parietes, in the hypogastric region, and the third, through the rectum. Of these, that through the perineum is the first to be selected, because it applies to the region in which the cause of retention is almost invariably situated; and by this operation we not only give effectual relief to the distended bladder; but we at the same time attack the disease, and though perhaps the most difficult of execution of the three operations, it is, as a principle, safer to operate on the urethra in the perineum than on the bladder in the pelvis. But the question of safety to the patient is paramount to any other that can be raised, and it is therefore selected on all ordinary occasions. It may be useful to point out the class of cases in which one or the other mode of proceeding should be preferred.

Puncture through the perineum.

Puncture through abdominal parietes.

The operation of puncture above the os pubis may be recommended for occasional adoption, on the authority of Mr. Abernethy, who gave to it a preference over either of the other forms, and has many times expressed to me his conviction of the advantages afforded by its selection. Its merits appear chiefly to consist in the facility of its performance, and the instant and certain relief afforded by it, and it should be selected in cases of extensive disease in the urethra or perineum, and especially in very enlarged prostate gland. But the necessity of opening into the cavity of the abdomen, or making a puncture through the abdominal walls, when the perineum affords a fair field for the operation, must be very rare; and to select this in preference to the perineal region, or to puncture through the rectum, without positive indications, is to prefer a greater danger to a lesser one. In puncturing the bladder above the os pubis, the trocar passes through two layers of peritoneum, viz., the layer that lines the abdominal muscles, and that which forms the external coat of the bladder. I am aware that this opinion is not a general one, for it is more consonant with common belief that the peritoneum is detached from the os pubis and from the bladder, in cases of great distension of this organ. But in favour of my own opinion I would point to the wonderful extensibility of the serous membrane in hernia, and ask the physiologist whether it is possible that because the bladder is unnaturally, or rather unusually distended, Nature would deprive it of the most extensible of its coats. I believe not, and on the contrary, I feel strongly the truth of my assertion, that the peritoneum is unaltered in its relations to both the bladder and the abdominal parietes.

Peritoneum punctured.

All that is required for the operation itself, is a simple puncture through the abdominal walls, immediately above the os pubis. The previous incision by the knife is not requisite, but is, on the contrary, to be objected to. The direction of the trocar is of moment. If the puncture be made too vertical, the instrument may pass between the bladder and the os pubis, and this occurrence I have borne witness to. If, on the contrary, it be made too horizontally backwards, although we may with certainty strike the bladder and evacuate its contents, yet as the organ contracts, the coats will hang on the canula, which

Direction of puncture.

will prevent its entire return into the pelvis, when emptied. Indeed the organ cannot be fully emptied on such terms. This error I have also seen. The direction that the trocar should take, is at about an angle of 45°, with the horizontal line backwards, carrying it downwards and backwards, towards the axis of the pelvis. Before the fluid is entirely evacuated, a piece of gum catheter, as large as the canula will admit, should be introduced through it, and the canula withdrawn. This instrument, being provided with a wooden plug, must be retained throughout the treatment, or until the natural passage is re-established. About three inches of the canula, or rather more than less, should be retained in the wound. This operation was performed on the late Mr. Bartleman, of vocal celebrity, who retained the instrument in his bladder for some two years before his death. He travelled about the country, with the instrument in his bladder, and without much pain or inconvenience.

**Puncture through the rectum.**

Puncture through the rectum.—This is for the most part a good method of evacuating the contents of a distended bladder. It is applicable to cases of retention dependent on old stricture, in which the exploration of the urethra in the perineum is contra-indicated, whether by reason of extensive disease, or by the urgent necessity of the case, for the relief is immediate. Still it must be considered in the light of a palliative, only by removing the effect, but leaving the cause untouched, while the perineal operation extending directly to the root of the disease, has for its object the removal of both cause and effect, the stricture or other form of diseased urethra and distended bladder. Called suddenly to a case of retention of urine, it may not infrequently occur, that both the surgeon and the patient may be unprepared for a protracted and, possibly, an unsuccessful operation. Immediate relief is required, and is afforded by simple puncture of the bladder, the treatment of the cause being deferred to a more convenient season. Puncture of the bladder through the rectum is applicable to retention from any cause which does not preclude the finger being brought into contact with the bladder in that direction. This contact, which is requisite in directing the trocar, is very difficult, and often impossible in enlarged prostate gland, which blocks up the rectum, and forces the bladder upwards towards the abdomen. Puncture of the organ through the rectum, therefore, cannot apply to retention from this cause; and the less so, because the bladder is always accessible to the skilful employment of the catheter passing through the natural channel.

In retention from stricture, especially if of long standing, in which the organ has been the subject of frequent dilatation, the walls can be felt distinctly on the introduction of the finger through the sphincter. The lower surface descends, and in cases of protracted retention, where the organ is largely distended, it is felt almost immediately within the sphincter ani. As a general rule, it is forced more or less downwards. The operation consists in passing a curved trocar in the mesial line, and through the most dependent part of the bladder.

This operation for puncture of the bladder, has been recommended, and largely adopted by Mr. Cock of Guy's Hospital. It is a good and I believe a safe operation; but it appears to me that the trocar usually employed, is somewhat unnecessarily large. Whatever evil consequences may be supposed to result on the removal of the canula, would be surely lessened by the reduction of the size of the instrument.

The bladder may be punctured through the rectum perhaps with less difficulty or danger than in either of the two situations previously described. When a finger of ordinary length is introduced into the rectum, in the healthy condition of these parts, the bladder can be barely reached behind the prostate gland. If considerable pressure be made, the bladder may, however, be distinctly felt. In cases of distended bladder, and especially if the contents be very large, the organ is forced downwards on the rectum, approaching, more or less, the sphincter ani. I have known it in a case of repeated retention to be carried down to within an inch of the orifice of the anus. Under ordinary circumstances the bulging of the bladder is sufficient, in positive retention, to render the operation of puncture by means of a curved trocar, of easy execution, and it has been performed so frequently, and is recommended so strongly by Mr. Cock of Guy's Hospital, and also by his able colleague, Mr. Hilton, as to have placed the question, both as to its efficiency as a remedial measure, and as to its danger, almost beyond appeal.

I can only second the recommendation of these experienced gentlemen, and express my belief that it possesses peculiar advantages, and that it may be resorted to in any case of retention, so long as the finger can be employed as a director to the trocar. In great enlargement of the prostate gland it is of course inadmissible, because in such cases the bladder is rarely, if ever, largely distended, and if it were capable of distension, the projecting gland would still present itself as an obstacle to the free employment and the safe introduction of the trocar. In such cases we have hardly an alternative to the operation of puncture above the os pubis.

The operation of puncture through the rectum is very simple. The patient is placed in the attitude for lithotomy. The forefinger of the left hand is introduced into the rectum, and its extremity brought into contact with the projecting bladder, which presents to it an elastic resistance. The trocar, the size of which need not exceed No. 8 or 9, protected by its canula projecting about half an inch beyond the point, is passed carefully into the bowel, upon the finger. These relations between the two portions of the instrument may be maintained, by both being grasped at their handle. When the canula is brought into contact with the bladder in the exact mesial line of the body, and at a distance as near as can be calculated, of about three-quarters of an inch behind the prostate gland, the trocar is pushed forwards, and the canula enters the bladder to the extent of from one to two inches. The relief afforded to the distended bladder is immediate, and the organ returns to its natural relations in the pelvis. The canula is fixed by four thick threads of silk to a belt or bandage around the abdomen or to a suspensory bandage, and the patient should be required to lie continuously on his back. The canula may be retained within the bladder for any reasonable period of days or even weeks.

## FISTULA IN PERINEO.

Unnatural openings into the urethra occasionally occur, following extravasation of urine or abscess, through which the urine flows in every act of micturition. There may exist one of these openings, or many. When produced by extravasation of urine they may be numerous. In one case that I treated, there were as many as six or seven in number, occupying the perineum, groins, and hypogastric region. This case was that of obstinate stricture, and it occurred in the practice of Mr. Abernethy, but was afterwards consigned to my care. The injury sustained to the urethra by the presence of these openings is very great. The canal becomes narrowed in front of them, and after a term of years is so contracted as to defy treatment by dilatation. Abscesses form in the neighbourhood of any part of the track of the urethra, and burst into the canal. I have recently had a case of this kind, in which the abscess formed in front of the os pubis, and burrowed down to the urethra in the perineum.

Contraction of urethra in front.

Little assistance can be afforded in such forms of disease by the aid of operative surgery; at least, until the first and most important indication is fulfilled, viz., that of rendering the entire canal of the urethra patent. This canal must occupy the first and exclusive care of the surgeon; for just in proportion as the above end is attained, will the openings heal. It is sometimes advisable to plug the sinuses with lint, which acts rather as a stimulant, than as a mechanical impediment to the flow of urine through them. It is very often necessary to confine the person to bed, and to leave an elastic gum catheter in the bladder for some days, through which the water will entirely flow. Conjointly with this treatment, the efficacy of general and elastic pressure is very serviceable, and its application for many hours in the day, or even throughout the twenty-four hours, if bearable, will accelerate recovery.

Treatment.

A case occurred to me recently, which illustrates this principle. I was requested to see a woman with several fistulæ about the anus and perineum. These sinuses were large, and communicated with the rectum, and whenever the bowels were relaxed, their contents passed freely through them in all directions. On examining the rectum, I found it so much closed as to render the introduction of the finger exceedingly difficult and painful. The repeated use of the rectum bougie, which was ordered to be retained in the intestine for an hour or two at a time, resulted in the closure of all the sinuses, and in the entire re-establishment of her health, locally and constitutionally.

## OPERATIONS ABOUT THE ANUS—HÆMORRHOIDS.

Treatment by pressure.

Hæmorrhoids may require removal when large, painful, or intractable to other treatment. Whether external, or within the verge of the sphincter, these cellulo-vascular growths are frequently amenable to well-applied pressure, the most efficient agent of which is that of the short metallic bougie. This instrument, about two inches in length, should be introduced into the rectum, and there retained in the sitting posture of the person, as long as convenient at each time, or a candle, or rectum bougie should be introduced daily, to the extent of two or three inches. A round fold of linen, of about the size of a towel, will be found a useful addition, if placed on the chair or seat, and employed at all times for external pressure, and for which purpose an elastic spring, terminating in a pad, placed over the anus, is sometimes requisite, to which the injection of cold alum solution may be added once a day. As an aperient, when required, two drams or more of castor-oil, with five to seven drops of tinct. opii each morning, will often afford great relief.

I am satisfied that these measures will often render the resort to the operation of removal, unnecessary; for, although they may fail to remove the morbid growth, which has been a source of so great pain and inconvenience, and often of loss of blood; yet perseverance in their use will so far reduce the size and activity of the growths as to supersede the employment of more active measures.

Excision.

Cases are recorded in which danger from hæmorrhage, and even death, has followed the removal of hæmorrhoids by the knife; and the bleeding may be formidable, if the operation be undertaken without due regard to the irritable nature of the disease. If the pile be firm, and not apparently congested, it will not bleed to any injurious degree; whereas, if full and rounded, if apparently distended with blood, as though strangulated, and painful on pressure, then some additional care is required. This growth may be removed either by the scissors or by ligature. The objection to the scissors is founded on the liability to hæmorrhage; that to the ligature, on its pain and inconvenience. I usually combine the two

Ligature.

operations, and by that means, I think, I avoid the evils of both.

The mode I allude to consists in passing a silk thread or a thin copper or iron wire in the form of a loop, made through a double canula around the root of the growth, and strangulating it by drawing the wire tight. This being accomplished, the canula may be retained in this situation for any length of time, from half an hour to an hour or more, and the pile may then be removed with the knife or a pair of scissors; and, as it is far easier to arrest bleeding at the commencement than when established, so, should bleeding occur, immediate pressure should be applied by the finger or by pads of lint. Serious hæmorrhage, however, is a rare occurrence.

Cautery.

The galvanic cautery is both an ingenious and often a very efficient agent employed for the cure of fistula in ano. It has been recommended by Mr. Marshall of University College. I have adopted it with success on several occasions. The wire is passed along the sinus, and through the orifice into the rectum.

Application of nitric acid.

All surgeons are familiar with one variety, in which the surface of the pile has a bright florid aspect, somewhat like a raspberry. It bleeds freely on the slightest touch, and is acutely sensitive. The most efficient treatment for this form consists in the application of strong nitric acid, as Mr. Houston has recommended.

## FISTULA IN ANO.

A fistula may be detected by the presence of discharge on the patient's linen, and pain on going to stool, accompanied by the orifice of a sinus at the side of the rectum. Sometimes the sinus is internal only, the orifice of which is incompletely formed, but is indicated by a red point on the skin, at a greater or less distance from the orifice of the anus. At other times the sinus has no communication with the rectum. This disease is often associated with pulmonary disease, and it behoves the surgeon always to make inquiry into the condition of the respiratory organs before he proceeds to attempt the cure of fistula in ano. This end may be attained by means of a thread passed through the fistula, when open, at both extremities, and tied loosely in a knot. The thread may be

Often combined with pulmonary disease.

Treatment.

allowed to remain for some days, or even longer, if the sinus do not appear conscious of its presence. When removed, the canal will heal rapidly, particularly under the administration of bark. When the fistula is complete, and the knife is to be rendered the agent of cure, a director is passed into the sinus and forced upwards to the rectum, upon which a probe-pointed bistoury is conveyed; the index finger, sufficiently greased, receives the probe point within the gut, and the bistoury and finger are withdrawn together. This act is facilitated by the integuments of the buttock being drawn tightly outwards by an assistant at the moment of withdrawing the knife, by the application of both his hands.

When the inner orifice is incomplete, a flat and smooth piece of soft wood should be used instead of the finger, and introduced into the rectum. A sharp-pointed bistoury is employed instead of the probe-pointed instrument. The point of the bistoury is passed through the mucous membrane and fixed in the wood, and the two are then withdrawn. These operations at the orifice of the anus should be performed on the person, while kneeling on a bed or couch, with the back depressed.

It is almost unnecessary to say, that whatever is placed between the sinus and the rectum must be divided, whether the orifice of the sinus be upon, or on the outer side of the sphincter ani.

In dressing the wound, up to the period of its entire closure, great care should be taken to prevent union of its sides.

# CHAPTER XXV.

## ON THE OPERATIONS OF LITHOTRITY AND LITHOTOMY.

INDISPENSABILITY OF RETAINING BOTH OPERATIONS — CONDITIONS REQUIRED FOR LITHOTRITY — INDICATIONS DEMANDING THE CUTTING OPERATION — SYMPTOMS OF STONE — ON THE EMPLOYMENT OF THE SOUND — OPERATION OF LITHOTRITY — DIFFICULTIES ATTENDANT UPON IT—CONSEQUENCES—LITHOTOMY—EVIDENCE OF STONE IMPERATIVE — INSTRUMENTS EMPLOYED — STAFF — GORGET—FORCEPS—OPERATION—SECTION OF PROSTATE — ENLARGED PROSTATE—AFTER TREATMENT.

I DO not purpose, in the following chapter, to carry the reader through all the elaborate detail of the history and progressive stages, up to the present era, of this important and interesting operation. I deal with the operation, not with its history, nor its progress. No one subject in surgery has occupied so large a space in the records of the past as this; and in none has the ingenuity of surgeons been more largely taxed for the invention of means by which to lessen the danger of the operation of cutting into the bladder, or, within the last quarter of a century, to extract the stone from its cavity by lithotrity, without the aid of the knife.

In reference to the operation of lithotomy, it may be said to have reached its highest degree of perfection, determined by the success that attended it, at the early part of the present century, since which time, although the steps of the operation may have been somewhat smoothed and rendered easy, yet the proportion of recoveries stands much where it did at the date alluded to —at which it was no uncommon or unreasonable boast, by many of the leading hospital surgeons of London, that they had successfully treated from twelve to fifteen cases of stone consecutively, without the drawback of a single death.

The great feature in the history of the present century is the introduction of the operation of lithotrity, which has reduced the amount of cases in which the knife was resorted to; and if we consider the multiplication of the London hospitals, and the progress of surgical science throughout the provinces, which has tended to lessen the centralising influence of the metropolis, it is not surprising that the examples of this disease in any given hospital should be greatly reduced in number at the present period.

*Symptoms of Stone.*—The presence of stone in the bladder is, for the most part, marked by an unequivocal train of symptoms; yet abundant examples are recorded of the existence of stone, and occasionally of large size, being unsuspected till after the death of the individual. But this is so much the exception to the rule, that little advantage can be derived from enlarging on this subject, because the interest connected with it is rather pathological than surgical, no active treatment being required in such a case, even if the existence of the stone were ascertained, so long as it is unaccompanied with symptoms of inconvenience.

**Factitious symptoms.**

The symptoms of stone in the bladder, although well marked, are closely imitated by a factitious train, which are frequently met with, and are very deceptive in their indications. We are frequently consulted by the parents or friends of children, who complain of irritable bladder, accompained by painful micturition, by emaciation and generally impaired health. The bladder is painful on pressure, and intolerant of the presence of urine. On passing a sound into the bladder, the pain expressed is very great, in a degree, indeed, beyond that complained of when stone is present. Pressure on the organ in this condition usually occasions positive pain. The peculiar feature of such cases is characterised by a marked roughness of the bladder, which is hard, and uneven to the touch of the instrument, apparently elevated into ridges, and rugous.

**Rugous bladder.**

I have described this condition of the bladder in children to my own pupils at the hospital for many years, often declaring that I have rarely or never known stone to be present under such circumstances; nor have I, and the moment I perceive it I generally withdraw the sound, as likely to aggravate the mischief. The only excuse for retaining it, is the satisfaction it may afford to a natural and just curiosity. These factitious symptoms, pointing to the possible existence of stone in the bladder, predominate largely in children, but are occasionally found in the adult; but it is in the cases of children especially that these remarks are intended to apply, because I have known examples of this condition of the organ, accompanied and occasioned by stone in the adult. I have at this time two examples under my care which may be deemed exceptions, in one of which chronic inflammation followed the use of the lithotrite, the stone being reduced to a small fragment; and the second example occurs in the person of an old man, with a large stone, who is now under treatment. The true symptoms of stone are not, as in this case, confined to the bladder, but extend along the urethra.

It is a well-known fact in surgery, that irritation at the neck of the bladder is referred to the glans penis, whereas disease either of the entire organ or of the prostate gland, is referred directly to the region affected; affections of the bladder to the organ itself, and prostatic disease to the perineum. In the real presence of stone, we have irritation of the neck of the bladder, caused by the contraction of the organ on the stone, which increases as the urine escapes; and hence pain in the glans, of a character which is somewhat relieved by friction or pressure, and consequently, the prepuce is drawn out and unnaturally elongated. This is a condition quite foreign to simple irritable bladder, whether accompanied or not by inflammation. So long as the coats of the bladder are separated from the stone by a quantity of urine, the bladder contracts without occasioning pain, but when a sufficient quantity has passed off to bring the two into contact, then pain immediately follows. This symptom is highly characteristic of stone. In stone, the expulsive efforts of the bladder are great, and hence frequent discharge of the contents of the rectum, and the sudden pressure of the stone on the neck of the bladder often interrupts the flow of urine from that cavity. This interruption may be repeated once or twice in each act of micturition. The presence of stone in the adult is often indicated by the addition of more or less of bleeding from the bladder, which is increased by exercise, especially on horseback, whereas, bleeding in children is not so common.

Pain from contraction at the close.

Add to these symptoms of stone, the presence of a dull, bearing-down pain in the bladder and perineum, and the admixture with the urine, from which it gradually separates after being evacuated, of a greater or less quantity of muco-purulent fluid, and we have the symptoms of calculus in the human bladder. Adults will often describe the sensation of the stone rolling from one side to the other, as the position of the body changes.

*On the Introduction and Use of the Sound.*—Unlike the catheter, metallic bougie, or staff, each of which it nearly resembles in form, the sound, introduced into the bladder, is employed as the representative of the finger, as the organ of touch; and as I have had occasion in an earlier part of this work to claim for delicacy of manipulation, a clearer perception, and a more correct inference as to the nature of structure, both morbid and healthy, so in relation to the use of the sound, I would urge the necessity of delicacy, of gentleness, and of tact in its employment, not so much to the end of avoiding unnecessary suffering to our patient—an object of *some* consideration—but to that of enabling us to appreciate with more nicety what is going on at the further end of the instrument. There is also another motive for gentleness in our movement; viz., that if force be employed, and coarseness of manipulation, in the case of a child, we have audible expression of suffering, and we lose the valuable aid of the sense of hearing, and are restricted to that of touch only. The patient should be placed in a position convenient to the surgeon and comfortable to himself. The sound should be rather small than large; contracted in the shaft, that it may play freely in the urethra, and short in the curve, that it may easily revolve in the bladder.

**Delicacy of manipulation.**

The instrument, well oiled, should be passed gently into the organ in the semi-recumbent posture of the patient, and the cavity is now to be systematically explored; first, in the centre from before backwards, by revolving the handle from side to side between the finger and thumb. The instrument is then to be withdrawn to the neck of the bladder, and its point directed, first towards one side, which should be fully examined, and then on the other; and, lastly, the handle being depressed, the point of the sound should be carried upwards,

**Manipulation for sounding.**

behind the arch of the pubes. If the evidence of the presence of stone be so inconclusive as to render further inquiry desirable; and especially so, if the bladder be empty of urine, which will be indicated by the point of the sound coming in contact with its opposite surface on its first introduction, and by the obstruction to its movements in all directions, then the instrument should be withdrawn, and the bladder injected with warm water, at about ninety degrees of heat, of which about two or three ounces may be thrown into the bladder of a boy, and about five or six ounces into the bladder of an adult. This part of the operation should be effected very slowly. The sound, again oiled, is to be reintroduced, and carried over the entire surface, as before. Should this fail in detecting the stone, the patient should be carefully laid back in the horizontal position, and the pelvis raised above the level of the trunk, by being elevated on one or more pillows. If the bladder contain a stone, unless it be encysted it will gravitate into the further part of the organ, and must be felt by carrying the sound backwards to meet and touch it. Should this proceeding, which need not occupy altogether more than five minutes, fail to detect a stone, our diagnosis is probably in fault, and the instrument should be finally withdrawn. Should, however, the presence of stone be detected, we must obtain all the knowledge of its size and nature, &c. that we can.

Injection of the bladder.

Density.

Its hardness and density will be indicated by its sonorousness; if very hard it will ring like metal, and when struck, the sound will be audible at the distance of many feet. This is the feature of the mulberry calculus; but the lithic acid stone is also distinct in the character and quantity of the sound it communicates. Whenever the presence of stone is audible to the bystanders, there can be no necessity for the adoption of a nearly obsolete practice, begotten in the days of the gold-headed cane and silk-stocking school, of handing over the staff to the charge of all the surgeons present in rotation, that their ingenuity may also be exercised in finding and striking it with the sound. If the stone be soft and inaudible; if its existence be equivocal, as in some forms of the mixed phosphates, then the surgeon has a right to claim an opinion from, and to share his responsibility with any number of persons present, and one or two of these should accept of this office.

Size.

The size of the stone, when discovered by the sound, can only be learnt by experience, and no rule can teach it; indeed the most experienced can but approximate to the truth. Still we may distinguish altogether some very important features in the case, which may guide the future operation and determine us at once as to the form of operation to be performed. We can ascertain with some certainty the degree of *density* of the stone, and thus determine on the probable force required; we can form an approach in judgment to *size*, and we can ascertain *position*, by which we shall be enabled more readily to seize it with the lithotomy forceps, if that instrument be afterwards used. We can only explain this question of position by recollecting the relations and the structure of the bladder; that with respect to relation, it is placed behind the os pubis, and in front of the rectum, and extends laterally beyond both; that in structure it is composed of muscular fibres, travelling over it in all directions, and which muscular fibres may grasp a stone when not very large, and hold it firmly in any part of the organ, whether the upper, the lower, or the lateral, in which locality, if undisturbed while yet small, it would probably eventually be retained. Hence the advantage of exploring the organ by the addition of warm water, by which the coats are distended, and the stone allowed to gravitate. The introduction of the finger into the rectum of the adult of full size, especially if the perineum be more than usually deep, is of doubtful service; no finger of ordinary size can do more than simply reach the bladder beyond the prostate gland, nor even reach the organ if the gland be at all enlarged. Those who advise the introduction of the finger into the rectum, for the purpose of drawing the stone forwards, and thrusting it into the blades of the forceps, have not had much practical intercourse with the operation for the removal of stone, or cannot be very familiar with the extent and relations of the prostate gland. If much time has been occupied in the examination, and much pain has been occasioned, the patient should be desired to lie down in bed for some hours, and a warm bath, and an opium suppository be used, if necessary.

**Probable cause of encysted stone.**

In estimating the value of one or other mode of ridding the patient of stone, we must calculate the results negatively as well as positively. We cannot acquire a sufficient insight into the merits of lithotomy without we also apply our minds to the results of the rival method of cure; viz., that of breaking up the stone within the bladder by means of the lithotrite. One fact is obvious, that the operation of lithotomy must be retained by all practical surgeons, as indispensable to treatment in many cases in which the resort to the screw of the lithotrite is as impossible as though it had never been invented; while, on the other hand, the known facility by which under favourable circumstances for the operation, a stone in the bladder may be broken to pieces, and entirely voided without pain or injury, or considerable suffering of any kind to the individual, gives such palpable superiority, on the score of security, to this mode of treatment over the former, that it would appear an unpardonable neglect of the interests of those consigned to our charge, to resort to the old operation. It is obvious, therefore, that of the two modes of proceeding neither can be dispensed with, and the first duty of the surgeon, in any given case, is to determine which method is the more applicable, and more likely to meet all its necessities. If we were to select a case for the exhibition of the operation of lithotrity,—and I take lithotrity as the rule, and the cutting operation as the exception, considering the simpler and the safer course to be that demanding the first consideration, and before the tribunal of which the case is to be first brought for trial,—if we had the power of selecting a case especially suitable in all its bearings, we should require the following conditions:—First, well-developing or developed manhood. Second, a healthy and readily dilatable urethra. Third, a bladder free from irritation, and capable of retaining at least four ounces of urine, a condition which infers the absence of prostatic disease. Fourth, a state of health comparatively speaking, sound; and, Fifth, the presence of a stone of such dimensions as to be capable of being embraced by the blades of the lithotrite.

Both operations indispensable.

Conditions essential for lithotrity.

But these conditions are rarely obtainable in perfection in any one case, and it remains therefore to consider, and to canvas, their relative value, in determining whether or not, in the absence of one or more of them, the operation of lithotrity shall be resorted to. And here let me observe, that such is my impression of the superior value of lithotrity, in all cases favouring its employment, that I deem the cutting operation only warrantable under such circumstances of the case as positively contra-indicate the breaking up of the stone. As I have above said, all cases are to be first canvassed by the appeal to lithotrity; if this appeal fail, the necessary alternative, the *pis-aller*, is the cutting operation.

**The knife the last resource.**

But it is because these conditions cannot be invariably found in combination, that the old operation will be frequently resorted to by the most earnest advocates of lithotrity; and the entire of my argument goes to this extent, and no further, viz. that this (latter) operation, being less dangerous, and equally efficient as lithotomy, should in all suitable cases be selected. Let us consider these requisite conditions a little more in detail, with the addition of such collateral and incidental circumstances as may occur in individual cases.

**Conditions for lithotrity.**

First. Well-developing or developed manhood is indispensable to the use of the lithotrite. Our lithotrity instruments, unlike the instruments employed in cutting, and made suitable to all ages, are necessarily limited in size; because all their substance is required for strength, in the possession of which quality their safety and only utility depends. It is impossible to make a lithotrity screw of a size admissible into the bladder of a child, that would bear the force employed on it without danger of breaking in the bladder, therefore well-developed boyhood at least, is indispensable; the operation of cutting being the only operation permissible in the case of a child; for I have no doubt that the operation of lithotrity may be rendered available, under favourable circumstances, to boys as early as ten or eleven years of age, by a reduction in the size of the adult lithotrite, and by careful dilatation of the urethra.

**Safety in magnitude.**

But even the manhood inferred by age requires healthy development of the genital organs, and most especially of the spongy body of the penis. If the glans be defective, or if any evidence appear along the track of the urethra, that nature has been sluggish in her formative power, then the sound alone can determine the

**Full development of organs.**

question. If a sound, equal to about No. 8, pass readily into the bladder, that is all that is required.

A dilatable urethra.

Second. A healthy and readily dilatable urethra. It is hardly necessary to say that the canal must be sufficiently large to admit of the passing of the requisite instruments, and these in relation to catheters in ordinary use, are of large size. A contracted state of the membranous portion of the canal is a frequent condition of the urethra in many persons, consequent on gonorrhœa, or its treatment, or both, or coupled with protracted gleet. Until this disease be removed, and the canal be rendered entirely patent to the instruments employed, no attempt can be made to break the stone. At the same time it must be recollected that this state of the canal almost equally precludes the resort to the knife by cutting, as it is impossible to introduce a staff into the bladder, to direct the course of the instrument. Any sized staff that can reach the bladder is admissible in lithotomy, in cases of necessity, as is evidenced by a case reported, under the charge of Mr. Syme, of Edinburgh, in which he employed an instrument much within the usual size.

Unless the seat of confirmed stricture of long standing, this diseased condition of the canal may be sufficiently removed by active treatment, to admit of the introduction of the lithotrity forceps.

A tolerant bladder.

Third. A bladder free from irritation, and capable of retaining four or more ounces of urine. The degree of irritability of the bladder varies greatly in different examples of disease, dependent partly on the constitution of the individual, and partly on the composition of the stone. We occasionally meet with persons possessed of a morbid irritability of the bladder, who are unable to retain their urine under any circumstances of mental provocation, and who habitually void it, in health, with greater frequency than other persons.

Enlarged prostate.

In some constitutions the introduction of any instrument is followed by rigors. Such symptoms would, so long as they continue, always contra-indicate the operation of lithotrity. Enlargement of the prostate gland would, of course, be objectionable in lithotrity, not only from the mechanical obstruction to the employment of the lithotrite, but that its presence infers a condition of bladder which often precludes its admission of a sufficient quantity of fluid to protect it from injury. Mr. Adams, however, who has written very ably on the subject, has reported cases to show that lithotrity may be most advantageously performed, even where the prostate is much enlarged.

Composition of stone.

In at least an equal degree is the composition of the stone an occasional source of irritability. Calculi, composed of phosphatic salts of secondary deposit, such as the triple phosphate, or the rare example of phosphate of lime calculus, almost necessarily infer disease of the bladder, and, of course, great irritability of the organ. In mulberry calculus, (the oxalate of lime,) the power of retaining the contents of the bladder is limited, possibly from the mechanical form of the stone, presenting so many angular projections from its surface, which are supposed to be sources of irritation to the coats of the bladder contracting upon it. I say, supposed to be sources of irritation, because considerable doubts exist as to the truth of this received doctrine. Oxalate of lime calculi, are occasionally unattended by pain, while in other examples considerable suffering is coexistent with the entire smoothness of surface of a stone of similar composition. When this irritation is great, and the calculus large of its kind, the bladder, consequent on its long intolerance of distension, has acquired a permanently contracted condition, which will not admit of the injection of the quantity of water at the time of the operation requisite for safety.

This condition of bladder is unfavourable for lithotrity, so long as it remains; but supposing all other symptoms favourable to that form of operation, this objectionable tate of the bladder must be got rid of, by frequent and daily injections of warm water, or decoction of poppy heads, which shall distend the organ gradually, under the sedative influence of opium, taken by the mouth or employed as a suppository; and as the distension of the bladder sufficient for the operation is not great, the difficulty may be removed by perseverance in this meaure, the time required for which will, of course, hold some proportion to the past duration of its irritable state.

Tonic health.

Fourth. A tonic or healthy condition of the entire ystem is, of course, most desirable. Yet so far as a state f impaired health is attributable to the presence of stone, o far is its removal indispensable to recovery. If a man's ealth suffer from the presence of stone in the bladder, it is obvious, as the focus of mischief, that the cause must be removed in order to effect his relief, whether by cutting open the bladder, or breaking up the stone while in it. No one would operate by either mode on a person suffering from other sources of illness, than such as would be removed by the extraction of the stone. A tonic condition of the system, therefore, may be desirable, but is not always attainable; and when the want of it is dependent on the presence of stone, we endeavour to patch up the constitution for the occasion, and select some opportune moment for the removal of the cause, while we devote ourselves more seriously to the re-establishment of the health of the person, when the cause is extraneous and foreign to the presence of stone in the bladder.

Magnitude of stone.

Fifth. The presence of stone of such moderate dimensions as to be admissible within the blades of the lithotrite.

If a stone be sufficiently large to give cause for inquiry as to its existence, it is not, I apprehend, too small to be caught by the lithotrite, employed with reasonable tact. If this difficulty be great, the attempt to place it within the grasp of the lithotomy forceps, will be equally so in the cutting operation, and nothing is gained, therefore, to the latter by the diminutive size of the stone. But a grave objection to lithotrity is obtained from the presence of a very large stone, and especially if, being of large dimensions, it be composed of the hard material of oxalate of lime. The stone may be so large in all its dimensions, as to be inadmissible between the blades of the lithotrite, when dilated to its fullest extent. Still, the peculiar difficulties of a case must command additional resources, and increased powers in the instrument. The lithotrite is not weakened in its mechanism by its blades being made to separate more widely asunder than the instrument ordinarily used, though other objections to this change may be suggested, for the bladder may not be so distensible as to admit of this alteration in the instrument. In addition to a large stone, the bladder may, and probably will, not be found sufficiently dilatable to admit of the injection into it of the requisite quantity of warm water, and without it the operation cannot be undertaken with safety to the coats of the organ. Again, supposing the stone to be very large and barely admissible between the blades of the instrument, it may possess the additional disadvantage of being very hard in structure, and the process of breaking such a stone is a very protracted one, and would require many repetitions of the operation, and occupy many months.

The attempt to expand the lithotrite in a contracted bladder is a painful, sometimes a very painful addition to the patient's suffering, and the attempt to catch it must be made with the greatest delicacy and tact. On the other hand, the danger of the operation of lithotomy is greatly increased when the stone is very large, consequent on the greater than usual extent of the incision into the neck of the bladder. On the whole, we may infer, that in cases of large stone, the objections *cœteris paribus*, to its removal by the knife, are greater than to its being broken up by the lithotrite. This, of course, supposes, that although large it is still capable of being grasped by the instrument. If this be impossible, there remains no alternative to the knife.

**Lithotrity contra-indicated.**

It has been stated, that unless contra-indicated by circumstances, the general treatment for stone by operation is that by lithotrity. It is an impossible operation in childhood, and, except under the qualifications above alluded to, unsafe even in very early boyhood ; it cannot be resorted to in stricture of the uretha, or in any morbid contraction of that canal, so long as the contraction continues ; the difficulty of the operation is greatly increased under circumstances of irritable bladder, with frequent micturition : it is objectionable in a stone of very large dimensions, and impracticable in a stone the diameter of which exceeds that of the instrument employed to crush it.

Suppose a case to occur in a young and healthy man, whose urethra is not disorganised by disease, whose bladder is capable of retaining its urinous contents for some hours before expulsion, and in whom the shortest diameter of the stone does not exceed fifteen lines, and that not composed of the firmest texture, we have as perfect conditions as we can desire for the operation of lithotrity.

**Diseased kidney.**

In incipient disease of the kidney, that evil is most liable to gain ascendancy during the period of treatment, caused by irritation, whether of the instrument or of the fractured stone when broken up in the bladder. Cases occur in which the crushing has been most successful, but where the escape of the detritus is very disproportionately small. Many days elapse, and the quantity collected will not fill

Inflammation of bladder.

half a thimble. Pain in the bladder follows, increasing after every renewed introduction of the instrument. Inflammation of the organ destroys the patient, and examination discloses a sacculated bladder, into the diverticula of which the fragments of stone are collected. Such a case occurred to me last summer in St. Bartholomew's Hospital.

In a second case, I sounded a man for stone. The stone was very large, and was placed within the blades of the lithotrite with difficulty, but I made no attempt to break it: at the end of a fortnight I repeated the examination with great care. This operation was followed by pain in the bladder, intermittent fever, and he died in two months of diseased kidney.

Lithotomy indicated.

The merits of lithotomy are apparent in the entire removal of the stone by one operation. It is in my opinion especially advisable, in all cases of stone in which the bladder is diseased, or even whenever it gives evidence of unusual irritability, whether from actual disease, or from a morbid susceptibility of its nervous system. Under these circumstances, it is desirable that the cause be at once removed, rather than the bladder be subjected to the repeated introduction of irritating instruments, the advantages derived from which are remote and uncertain, while the evil is immediate and positive.

The danger from the operation of lithotomy, especially in young children, when well performed, and when free from the unfavourable concomitants of an impaired state of health, impending liability to renal disease, unhealthy organs, and a stone of large dimensions, is comparatively small. But still there is danger, as evidenced by the proportion of deaths occurring from it, and this danger, whatever its amount, is not sufficiently met by the great advantages arising from the entire removal of the *causa mali* to justify any approach to an indiscriminate resort to it.

The average mortality in cases of lithotomy operated upon in England, is about three in twenty-three cases:* this is the statistical report given by Mr. Crosse of Norwich, and is obtained from the report of seven hundred and four cases, operated on in the hospital and city of Norwich, and it corresponds with a similar average given by the late Mr. Liston, and other eminent surgeons. M. Lisfranc,* in reference to the mean mortality of cases operated on in Paris, gives the deaths to the recoveries as one in four; Dupuytren† one in five and a half.

---

* I suspect that no two persons will be found to agree entirely upon this subject. It affords a striking example of the *fallacy* of statistics.

## ON THE OPERATION OF LITHOTRITY.

Case of muco-purulent secretion relieved by operation.

The attempt should rarely be made to break the stone, so long as the patient complains of much irritation in the bladder, or if such irritation be evidenced by the escape of muco-purulent fluid with the urine. If the urine be clear, and the bladder free from pain, the stone may be broken; yet there are exceptions to this rule. I broke a stone in the bladder of a gentleman in apparent health. The operation was followed by chronic inflammation of the bladder, and a profuse discharge of muco-purulent secretion, which continued for months. In a consultation with Sir B. Brodie, he advised my repeating the operation. I broke the stone freely, and the bladder quickly regained its healthy condition.

Operation.

The operation is usually a very simple one if well performed. The patient should lie on the end of a bed, or on a sofa, with his pelvis somewhat raised on a pillow or cushion. Through a full-sized catheter is then injected into the bladder about four to six ounces of water, at the temperature of about 85° or 90°. This should be done slowly. If there be the least difficulty in introducing the catheter in the horizontal position of the patient, he should be raised for the purpose. It is not a favourable position for that operation at any time, perhaps because we are unaccustomed to it. Before removing the catheter it may be employed as a sound, and moved about gently in all directions. It is presumed that the presence of stone has been placed beyond all doubt. In such a case, *whether the catheter strike the stone or not, the operation should be proceeded with.* The lithotrite forceps, having been previously well studied, and their mechanism thoroughly understood, and readily manipulated by the operator, should be introduced warm and well oiled.

---

* Lisfranc in Rapport sur la Taille et la Lithotritie. Paris, 1835.

† Mém. sur une Manière nouvelle de Pratiquer l'Opération de la Pierre. Paris, 1836.

This part of the operation should be done with care and gentleness. On reaching the bladder, the instrument should be passed fully beyond the arch of the pubes, and into the centre of the cavity of the bladder. Unlike the lithotomy forceps, which are employed to find the stone and follow it to its position, the lithotrite takes its position in the bladder, and the art of the operator consists in bringing the stone into its grasp. This is an important distinction between the action of the two instruments. On dilating the blades of the forceps, or rather in withdrawing the near and moveable blade, if pain be expressed, it is probably due to the instrument not being pushed far enough into the bladder; the consequence is, that the moveable blade presses against the neck of the bladder, and the instrument expands with difficulty. Even though pain be not experienced in withdrawing the near blade, the act of dilating should implicate both of them. *The remote blade of the instrument should be pushed downwards into the base of the organ, at the same moment that the near blade is drawn upwards.*

Lithotrite not to be employed as a sound.

Pressure of remote blade downwards.

When fully dilated, as proved by the scale at the handle, the lower blade is to be pressed firmly against the base of the bladder, and forced downwards against the rectum, giving the instrument at the same moment a jerk, which extends to the whole organ. By this pressure it is intended to depress its base, and elongate the bladder downwards into the summit of a cone, at the bottom of which the fixed blade of the lithotrite rests, and by the jerk the stone, if free, will almost necessarily fall upon it. If this shake or jerk of the hand create alarm in the mind of the patient, the same end may be obtained by giving a smart blow to the side of the pelvis with the open hand, or by taking the pelvis between the hands, and shaking it from one side to the opposite. One movement is sufficient. The stone falls on to the lower blade, and the instrument is screwed home.

On the occasion of the first operation it is safer to withdraw the lithotrite when the stone is once broken, but on all subsequent occasions the stone may be caught and crushed several times, perhaps six or eight, or even more, provided we are not deterred by increasing pain. The entire operation may be completed within four or five minutes. The forceps, completely closed by the screw, are then to be withdrawn, and the contents of the blades examined. Before withdrawing the instrument, and especially if pain be expressed, the blades should be opened to the extent of about one-eighth of an inch, until the end of the instrument reaches the neck, or at least the middle of the cavity of the bladder; they may then be screwed home, and withdrawn.

Avoid the mucous membrane.

It is a common practice to urge the patient to get rid of the fluid contents of the bladder on rising. This attempt is generally futile, and is better avoided. The bladder appears paralyzed by the violence done to it, and it more frequently happens that even continued straining fails to expel its contents. If the presence of the contents create much inconvenience, a catheter should be introduced, and the water drawn off. The patient is placed in bed, and a warm bath used, if requisite, to allay pain, and a suppository of opium may be introduced on the same conditions. From the period of the operation, the patient should be directed to pass his urine through a gauze, strained over the vessel. It often happens that a far less quantity of the fragments of the broken stone pass off in the first day than later. The operation may be repeated, so soon as the detritus of the broken stone is come away, and all irritation has subsided; and this may require a period of a week, ten days, or a fortnight, or more, when the operation may be repeated, as before.

Importance due to the last fragments.

As the stone becomes reduced in size, the difficulty in seizing the remaining fragments may be somewhat increased, but it is all important that the residue of the stone be broken up, and additional care be bestowed on this important crisis of the case.

Consequent on the operation for lithotrity, is the occurrence of an occasional evil of some magnitude, viz., the lodgment in the urethra of a fragment of stone. Retention may follow, with pain, swelling, and inflammation of the canal, often attended by great suffering.

This evil is of more probable occurrence in those cases of irritable bladder, in which the organ is very intolerant of urine, as evidenced by frequent micturition. Here the power of contraction of the bladder is too greatly reduced to enable it to expel the detritus of the stone, should a fragment of magnitude pass into the urethra. Under

Urethra filled with fragments.

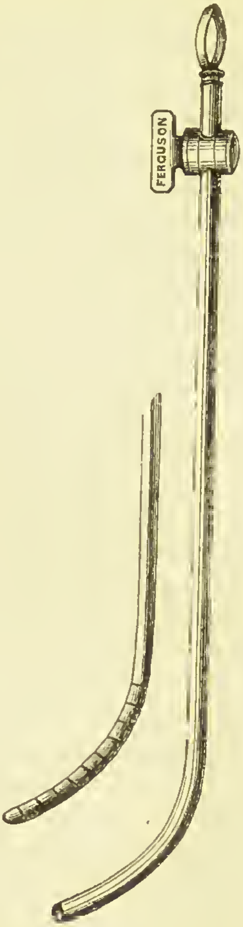
such circumstances, I once found, in the case of a gentleman in whom the operation had been performed but thirty-six hours, that the whole canal was distended, from the glans down to the perineum, from which I removed a very large quantity. This I effected in the following manner. I removed all the fragments within about two inches of the orifice, by means of forceps, and then endeavoured to pass a catheter into the bladder; but the canal was already occupied with stone, and I failed in this attempt. I then injected the urethra, and sufficiently filled the bladder with warm water, to excite an irrepressible desire to evacuate it, and at each effort a quantity of fragments escaped. This I repeated till I had removed the whole mass. It is somewhat curious that the entire quantity broken was at this time in the urethra, and it was sufficiently great to fill half a large walnut-shell. Such cases of reduced muscular power of the bladder require extra care and watching.

Under ordinary circumstances, a long probe or director should be passed down the canal, very gently, to ascertain the position and the size of the fragment. These features, however, supposing it to have lodged within the penis, may be made out more readily by the finger, but not if in the perineum. A long and fine pair of forceps, well oiled, should then be passed downwards, and the piece pushed backwards towards the bladder, about the eighth of an inch or more, turned round, and drawn out. This movement is necessary to disengage it from the fold of mucous membrane by which it has become involved. If it be seized by the forceps the moment it is felt, the mucous membrane itself will be caught by the blades. If the fragment lodge in the perineum, and we fail in our attempts to disengage it, one of two courses is open to us, either to push it back into the bladder, or to cut down upon and remove it. Of these two courses, the first has the least objections; and the endeavour should be made with a large metallic instrument.

Stone lodged in the perineum.

For the purpose of returning the fragment into the bladder, I have usually employed with advantage a full-sized catheter (No. 12), the open end of which is occupied by a round silver knob connected by a wire, by which it may be withdrawn. The instrument being passed down the canal to the point at which it strikes the stone, the ball is withdrawn, and the fragment is partly embraced by the round clean edge of the catheter, and by the pressure of the instrument it is conveyed back into the bladder without injury to the mucous lining of the canal. Should this attempt, well executed, fail, and retention, or even great suffering without retention, continue, not removed by the warm-bath and opium suppositories, we have no alternative but to cut down, and remove it. The objection to this proceeding is, that we operate for that single fragment, and effect nothing for the remainder of the stone. The fragment is removed, and the difficulties of the case are rather complicated by the wound in the perineum.

For the purpose of removing a fragment, we make an incision straight down upon it, almost without reference to the anatomy or to the structures divided. There can be no necessity for making an incision larger than sufficient to get it away. It should be seized, when exposed, by a pair of dressing forceps, and the fold of mucous membrane carefully detached around it. Unless the wound be large, the urine will always prefer its natural channel. An impression prevails of the greater advantage of making such an incision behind the scrotum, than through, or in front of it, grounded on the real or supposed difficulty of healing a wound made forwards into the urethra. I should be very unwilling to push a fragment that had lodged within one or two inches from the orifice of the canal, backwards into the perineum, although the objection may apply to division through the scrotum.



Opening the urethra through the scrotum.

The instrument here figured is well adapted for the purpose described in the text. It is such a one as I ordinarily use to inject the bladder before breaking the stone.

## ON LITHOTOMY.

Evidence of stone conclusive.

The first step towards the operation for the removal of a stone from the bladder is that of ascertaining, beyond all doubt, its presence in the bladder. The indispensability of this law in operative surgery is acknowledged by all good surgeons. I myself witnessed two operations unproductive of stone, in the early period of my professional career. This was formerly not so very unusual an occurrence; and I remember to have heard it asserted of a surgeon, who was so unfortunate as to have his cutting propensities called into frequent requisition, that he never undertook this operation without being provided with a well-selected stone in his pocket!

The table selected should be firm, narrow, and of a suitable height. This height is rather relative than positive, referring to that of the chair or stool on which the surgeon takes his seat. It was formerly the practice to operate on one knee, but it is an objectionable position on many accounts. The patient should sit on the end of this table, leaning back in a semi-recumbent position during the introduction of the staff.

If the contact of the staff and the stone be distinctly audible to two or three persons, while directed by the hand of the operator, it is sufficient.

The old grievance, that of operating upon deficient evidence of stone, has, as might be expected, led into a fault of the opposite kind; and now, unduly influenced by fear of error, operating surgeons shrink from a necessary responsibility, and exhibit a hesitating faith in the evidence of their own senses. In the cases of lithotomy, (if the term in such examples be etymologically correct,) in which one important feature of the operation, viz., the presence of a stone, was wanting, it should be recollected that a stone had not on any previous occasion been felt, for the bladder had never contained one; whereas, in the examples I allude to, a stone *has* been felt and heard, and its presence acknowledged by many. It is a very good and salutary rule in lithotomy that the presence of stone in the bladder be ascertained at the time of the operation. But, on the other hand, it is well known to all persons familiar with the structure of the bladder, under circumstances of such disease as may have interrupted the concentric form of its natural contraction, by the interposition especially of a foreign body, that we may find nooks and corners in any part, which accident alone may occasionally detect. If the evidence of stone, ascertained within the period of a day or two be conclusive, and if at the hour of operating any one competent authority declares that he has felt the stone at the instant, it is sufficient to justify its performance. If the operator have reason to place confidence in the competency of that person, whose assertion is unequivocally and confidently made, although ten or even a hundred persons fail in their attempt to acquire the same evidence, such negative evidence ought not to counterbalance the weight of his positive testimony, backed by the already-ascertained fact of the presence of stone within a day or two, and by the symptoms of stone which have continued up to the moment. Under similar circumstances to these, I have known many a patient returned to bed, with the operation unperformed. This practice is not dictated or governed by the laws of evidence, and betrays a want of moral courage on the part of the operator.

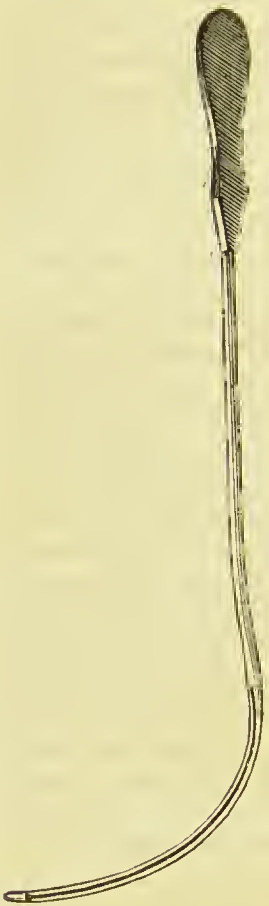
**Kind of evidence.**

*The office of the staff* is that of conducting the knife along its groove into the bladder. This instrument has assumed forms quite Protean in variety, from the largest curve up to nearly a straight line. The latter form was adopted by the late Mr. Aston Key, who operated with great success, but I do not think it will be found a safe instrument, for reasons I shall presently give, or that its employment will be found to facilitate the operation. The staff in general use is objectionable, because its point, when held vertically, barely reaches the bladder, and requires the handle to be depressed during the operation; whereas, from the moment of the first incision to the final cut into the bladder, the staff should be held firmly and immoveably, whether by the assistant or by the operator himself. In order to perform the operation of lithotomy with ease and safety to the patient, the point of the staff should be at least an inch or more within the bladder from the beginning. I am quite aware that it is the practice of some surgeons to depress the handle of the staff, while cutting into the bladder, but I cannot consider the practice otherwise than a

**Staff.**

**Staff should be immoveable.**

dangerous one, nor does it appear to me to answer any useful purpose, so long as we have the power of placing the instrument, at the commencement, in the track along which we have to divide throughout the whole of the incisions. Again, in order to meet one of the difficulties in the operation of lithotomy, that of cutting into the groove of the staff, it is desirable that the staff be brought *close to the surface of the perineum,* and distinctly felt by the finger pressing it; and in order to facilitate the easy passage of the knife along its groove into the bladder, the horizontal or last position of the instrument should be as straight as possible. The straight staff of Mr. Key, however successful in his hands, has this defect, that it forms no guide, and, as it were, gives no support to the first incision. It is, however, very efficient as an agent of directing the second incision into the bladder, when its groove is once opened. The projecting convexity of the staff should be distinctly felt on the perineum before making the first incision. This is impossible, either in the case of the common staff, or in that adopted by Mr. Key. The curve I recommend has another advantage, viz., that it elongates, or renders tense the perineum, in which state a cleaner cut is made through it by the knife. If made convex in the perineum and straight beyond the curve to the point, these two important indications will be answered, viz., facility of exposure of the groove, and ease in the transmission of the knife into the bladder.



Semilateral groove.

In reference to the groove, it should be as large and as deep as possible, consistent with the strength of the instrument, and especially so in that portion which projects into the perineum, and at which point it is first exposed. The groove may be made in front or on the side, or intermediately between the two. I have usually, with Mr. Liston, preferred the latter. The lateral groove does not appear to me to answer any useful purpose, and is certainly not so readily exposed, and the front groove, if it be necessary to keep the staff in a fixed position, does not permit of its entire depth being employed by the knife in cutting along it into the bladder. The groove should terminate at about the distance of a quarter of an inch from the extremity. The handle of the instrument should be large and strong, that it may be firmly grasped by the assistant, who is responsible for its entire immobility, until desired to remove it.

Mode of holding the staff.

The mode of holding the staff by the assistant is all important. The best and most conveniently formed staff may fail in its office, if negligently held, and abundant injury result to the patient. It should be held by the right hand of the assistant, or rather by the stronger extremity, it is unimportant whether by the right or left. A rule formerly prevailed, that the staff should be held by the left hand. I could never obtain an explanation of the necessity, and I broke the rule in my first operation. The staff should be well supported, and more than supported, it should be *raised and drawn towards the arch of the pubes*, and there held until the bladder is opened. If, in a protracted operation, the arm of the assistant becomes fatigued, he is apt to let the staff gradually sink on to the rectum for support and steadiness, for the position is an irksome one, and fatiguing to the muscles of the arm under untoward circumstances, by which the operation is prolonged. If, in the performance of the operation of lithotomy, the rectum is wounded, it is generally the fault of the assistant, not of the principal. It may be entirely avoided by the horizontal part of the staff being made straight, and by the instrument being well raised against the arch of the pubes by the assistant.

Knife.

The cutting instruments employed have been greatly simplified of late years, and so far improved.

Objections to the gorget.

Objections to the gorget may be found in the necessary change of instrument; secondly, in the great extent of its cutting edge; and, thirdly, in the force required to carry it through the prostate gland into the bladder, due to the imperfect angle at which its cutting edge meets the surface to be divided by it. The evil of the second objection can only be remedied by aggravating that which is incidental to the third.

Long, straight, probe-pointed knives were then substituted, and, among others, was one long employed by surgeons, and recommended by Mr. Thomas Blizard. The objections to this modification are, first, the necessary change of instrument, and, second, the uncertain extent to which the prostate may be divided, and regulated by this knife with difficulty.

The entire operation should be completed with one knife, as first performed by Mr. Aston Key. Any strong scalpel will answer this purpose, but it is well to have the back of the knife curved a little downwards at the end, in order to prevent the point of the instrument hitching in the groove while passing along it, and the point should be obtuse, being formed by the back and cutting edges, each curving to meet the other. There is no advantage in having the cutting edge of its usual length. In the ordinary scalpel, not more than one-third of the length of the blade is often used, and one inch will suffice to effect all the cutting required of the lithotomy knife. When of considerable length it is a clumsy instrument, and ill adapted to the hand in making the first incision. The handle should be long enough to admit of the point being carried into the bladder, while held firmly in the hand.

Knife blades unnecessarily long.

Forceps.

Unnecessarily heavy.

The lithotomy forceps should be adapted to the size of the organs operated on. I have myself a great objection to the ponderous instrument in common use, for the same reason that I have an equal objection to the force occasionally employed in dragging a stone out of the bladder through an opening inadequate to its transmission. It is difficult to exhibit delicacy of tact with a large and clumsy instrument, the very character of which unconsciously conveys its influence to the hand that wields it. Forceps should be made lighter and thinner than those now in use, and should occupy as little of the wound, in addition to the breadth of the stone, as possible. They are more tenacious if the blades be lined with kid leather. The handles should resemble the entire loops of scissors. When one end is open, formed by a simple curve in the metal, the finger not infrequently escapes from the loop, and the instrument slips from the hand. Additional security in the power of retention of the stone is given by the application of a ring of India rubber, connecting the two handles. Two or three varieties in the size of the forceps may be required in each operation.

Syringe.

An injecting syringe, and a short gum catheter tô fit on to it, is requisite in every operation for lithotomy, be it required for use or not, and is employed in all cases in which the stone is broken, to wash out the bladder. To effect this object an elastic bottle is a very bad substitute. The explusive force is difficult of regulation, from the necessary effort required to effect its steady and continuous pressure. The current issuing from it is irregular, and often interrupted, and its direction is always regulated with difficulty. The scoop is an instrument called into rare though occasional use. It may, however, be required to co-operate with the index finger to extract fragments of broken stone.

Position of patient.

One word with respect to the means employed for fixing the patient in the required position. The close apposition of the palms of the hands to the feet, is a matter rather of convenience than necessity in the well performance of the operation. Generally speaking, there is no objection to it, irksome and disagreeable as it may be to the patient. But in old age I protest against it, as barbarous and inhuman. I once heard an old man say, "it was more painful than the operation," and I do not see why straps of leather should not be fixed around the wrists and the feet, which, being brought together, might be adjusted to the flexible capabilities of the patient, whether in mid-life or in old age. The garters are more frequently applied inefficiently than well. In a protracted operation it is not unusual for the extremities on one or even both sides, to escape. They should be rolled smoothly around both wrist and ankle, and deliberately applied by each person, without reference to the proceeding of the opposite party. The failure in the application is occasionally due to a perhaps unconscious sentiment of rivalry between the two assistants!

Before I proceed to describe the operation for lithotomy, I think it necessary to make a few remarks on the subject of the structures divided by the knife.

No two descriptions can more entirely differ from each other than that of the anatomical, and that of the operating theatre, in reference to the operation for stone.

Anatomy of perineum.

By the non-practical anatomist we are told to make a superficial incision of certain dimensions through the perineum, to avoid the bulb of the spongy body, to beware of the artery of the bulb, to exercise due caution that we do not divide the pudendal artery, to open the urethra behind the bulb, which is required to be pushed on one side by the finger, to avoid the perineal artery, to cut the triangular ligament, urethra, prostate gland, &c., &c. But what surgeon permits such rules to occupy his mind from the moment he takes the knife in his hand? The operation for lithotomy is really under few restrictions from anatomy. The only important rule consists in not extending our incisions too far from the mesial line.

Division of bulb.

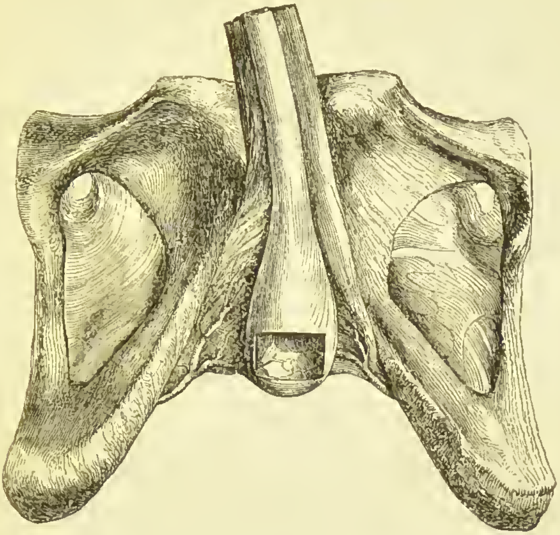
We are directed not to divide the bulb. Why not divide the bulb? It is an unimportant structure, and may be cut with impunity. The bulb was always necessarily divided in the Marian operation of dilatation. Yet we hear nothing of hæmorrhage. We are told to beware of the artery of the bulb. Whence this caution?

Artery of bulb.

The artery of the bulb is scarcely larger than a digital artery, which we rarely tie when divided. In order to avoid these two objects, we are directed to introduce the finger into the wound, and press the bulb and rectum out of the line of division. Who ever saw the finger introduced into the wound for this purpose, or, indeed, who ever had a passing thought of either the bulb or its artery, from the moment of his first incision? My experience of the structures divided in lithotomy is obtained from many dissections of these parts, after operations on both the living and the dead, and the result is this, viz.,

Generally divided.

that the bulb is always more or less divided and the artery of the bulb frequently, and the perineal artery rarely escapes, when the external incision is more than usually long. I would go further, and say, that I do not see how it is more than possible to avoid the bulb. If the reader will recollect how entirely the membranous part of the urethra is concealed behind it, and how necessary, for the avoidance of the bulb, would be either a very circuitous route taken to the prostate, or else an external incision made considerably further from the mesial line than the directions require, I think he will agree with me that the only mode in which the given instructions for the direction of the line of operation can be obeyed is by cutting straight backwards through the side of the bulb.



**Limited division of prostate.**

The practical surgeon of experience has another advantage over the unpractical anatomist, in his better knowledge of the kind and extent of the incision of the prostate gland, and of all the rules connected with the subject of lithotomy, if there be one more important than another, it is that which guides us in our division of this organ. Upon the extent of this division the question of danger may be said to rest, the safety of the operation being almost in a ratio with the limited extent of the incision into it. Such were the grounds of success attending the Marian operation of dilatation of the prostatic portion of the canal, as well as that of the late Mr. Martineau of Norwich. This opinion was adopted by Sir Astley Cooper, and is adopted and advocated by

The above sketch is taken from a preparation in the Museum of St. Bartholomew's Hospital.

Sir Benjamin Brodie; by Mr. Green, one of the most successful lithotomists in England, and by many other eminent men. By all these authorities we are told that a large division of the prostate gland enhances the danger of the operation, by increasing the liability to infiltration of urine into the pelvis. A sufficiently large incision is made into the prostate gland, if it admit the passage of the fore-finger through it into the bladder. But as this opening is insufficient for the passage of the stone, it must be dilated by the finger, and by the forceps. The gland is said to be extensible in its structure, and the opening through it certainly admits of considerable dilatation. Hence the evil of cutting knives and gorgets, which are uncertain in the extent of their incision. It is then a golden rule in lithotomy, to extend the incision very partially through the prostate gland, and to complete the opening by dilatation.

**Opening completed by dilatation.**

As a preliminary measure, it is essentially necessary that the rectum be free from contents at the time of operating. This may be effected by a small dose of castor-oil, given early on the morning of the operation; and by enemata, if necessary, administered immediately before it.

*Operation.*—Before the patient is brought into the operating-room, I conclude that some idea of the size and composition of the stone has been formed, by which we may in some measure regulate the extent of the first incision; that the patient's stomach be free from solid food; that the rectum has been cleared of its contents without purgation; and that, if necessary, the perineum has been shaved. An efficient and suitable table and a good light obtained, the immediate preliminaries to the operation may be commenced, by the introduction of a catheter, through which about four ounces of water should be injected with a syringe, if it appear on inquiry that the bladder be empty. If two or three hours have elapsed since the patient has passed water, this proceeding may be dispensed with. The staff is introduced in the semi-recumbent position, and is employed as a sound to detect the stone. When felt, the hands and feet of the patient are to be bound together by the garters, on the conditions previously given. The operator takes his seat in front; adjusts the staff, the handle of which

**Injection of bladder.**

he inclines somewhat over to the patient's right groin, thereby directing the groove towards the side on which he operates, unless the groove in the staff be lateral. The knees are to be separated by two persons, one of whom should support the scrotum, if pendulous. Before commencing his first incision, the surgeon presses his finger on to the perineum, to render himself quite clear as to the exact degree of projection of the staff, and its position.

First incision.

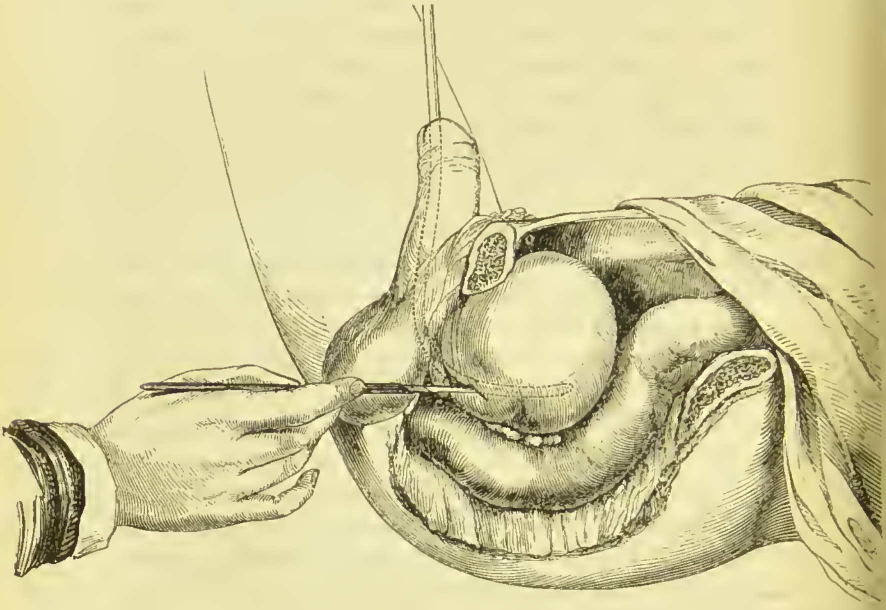
The first incision should be commenced one inch and a quarter above the orifice of the anus, in the full-grown adult; three-quarters of an inch in a child, either in the mesial line, or about one-eighth of an inch to its left side. At this point the knife is introduced, and pushed straight backwards at once into the groove of the staff. Having reached the groove, the incision is then carried obliquely downwards, slowly and deliberately, between the tuber ischii and anus, but nearer to the former, to the extent of about two inches in the adult, but proportioned to the probable size of the stone, diminishing in depth as we recede from the mesial line. The lower part of this incision exposes the deep fat of the ischio-rectal fossa. The fore-finger of the left hand is immediately introduced into the wound, at its upper angle, to feel for the groove.

Groove exposed.

If the urethra be opened, the finger-nail should guide the knife at once into it. If the opening be not completed, the nail should be pressed firmly on the groove, and an incision made into it upon the nail. This incision is effected more readily by turning the edge of the knife upwards, and cutting into the groove from below. When the groove is distinctly bared to the extent of some three or four lines in length, the point of the knife is to be placed in it, the contact of the two metallic surfaces is too palpable to render it necessary for the operator to raise his head, with a view to compare sensations with the assistant holding the staff. The knife should then, by the gradual movements of the fingers, be advanced from the hand, at least three inches in length; care being taken that during this change of the relations of the two, the point does not slip from the groove. If everything has hitherto gone on smoothly and the surgeon has entire confidence in his assistant, he may pass the knife

Staff taken by operator.

onwards at once into the bladder. I, with some others, find it preferable at this stage to take the handle of the staff in the left hand, while making this important division. We may thus avail ourselves of the natural harmony of action, always existing between the two hands of the same person. In passing the knife onwards along the groove, it is to be directed forwards, with the handle slightly depressed, and may be held either in the first position, viz., that of a pencil, or may be grasped by the fingers while resting on the palm. The point should be urged on till it reach the end of the groove of the staff in the bladder. Throughout this incision the back of the blade should exercise some pressure against the groove, which will render the escape of the knife from it more difficult. The fore-finger, in constant requisition, quickly follows the knife, through the opening made into the bladder, which is succeeded by a gush of urine. If the opening in the bladder be sufficient to admit the fore-finger with ease, the forceps may be introduced.



Size of opening in the prostate.

If the opening be small, and yet not too small to require enlargement by the knife, the staff should remain, and the finger be employed for a few seconds in dilating the opening through the prostate. The forceps may then be introduced, warmed and oiled, along the staff, but guided by the left index finger. When the forceps has entered the bladder, the staff may be withdrawn by the assistant. The forceps, on entering the bladder, is not to be opened, but should be employed as a sound, and moved gently about to find the stone, and having come into contact with it, then the blades may be expanded upon it, and the stone seized. In the endeavour to extract it, some force and some tact are required. It is very natural for a young operator, in the triumph of a moment which shall complete a hitherto well-executed operation, and who is conscious that his seconds, perhaps his minutes, are numbered by some friendly bystander indulging in the vicious practice of counting the time by his stop-watch, or himself betraying the yet more culpable folly of admitting its influence on his actions, to draw his operation to a close, by the injudicious employment of unwarrantable force.

**Line of traction.**

This force, whatever its degree, should be exerted in such a direction as to avoid the chief obstacle, namely, the bone. For this purpose the line of traction should be made obliquely downwards upon the rectum, inclining the stone towards the more dilated opening, formed by the expanded rami of the ischia. By drawing straight outwards, the progress of the stone is arrested by the contracted opening formed by the bones converging towards the arch of the pubes.

**Force in extraction.**

**Second division of prostate.**

This should be avoided. If a considerable and persistent effort be made without success, the forceps should be turned to find, if possible, a more suitable axis for its passage. The effort should be slowly and steadily made, in the assurance that the wedge-shaped surface presented by the forceps will eventually succeed. Not that I would counsel the continued application of force: if the opening be too small, if some minutes have elapsed, it is better to dilate the wound to the extent of some two or three lines. If this dilatation be rendered necessary by the *smallness of the opening*, the incision should be made in the direction of the former line of division; if in consequence of *the unusual size of the stone*, far better to divide the opposite lobe of the prostate, through which a large addition may be made to the size of the opening, without the risk of evil resulting from the division of the gland close upon its lateral surface.

When the stone is removed, it should be examined, with a view to determine whether it be entire or solitary. If fragments be left behind, either in the bladder or in the wound, too minute to be caught in the forceps, the bladder should be washed out by the syringe. The largest-sized elastic bougie being introduced fairly within the cavity of the organ, an eight-ounce syringe may be emptied once or twice, with force, into it. During this operation it will facilitate the escape of the loose fragments if the trunk of the person be raised as upright as possible. The garters should be removed at the earliest moment practicable.

Hæmorrhage.

The quantity of blood lost in an operation for lithotomy varies a good deal in different subjects. It may be comparatively large or small. The chief flow of blood follows the first stage of the operation, and is produced from the venous system of the region. The only arteries worthy of mention which are liable to be divided, are the artery of the bulb and the perinæal, both of which conjointly could not produce the quantity lost. This bleeding is not in the least degree alarming, and may be permitted to flow for any moderate length of time. The arterial bleeding is from the artery of the bulb, and in rare cases, is very protracted, continuing for an hour or more to trickle from the wound. No attempt need be made to plug or otherwise stop it, unless the bleeding affects the general circulation.

Pudendal artery.

The trunk of the pudendal artery is in no danger in the operation of lithotomy under the circumstances of its ordinary course. We may almost affirm that it is impossible to divide it. It could only be divided on the dead subject, by scooping the knife round with a long sweep, within the left ramus of the ischium, where it lies three-quarters of an inch from the margin of the bone. In some cases, the artery pursues an irregular course, but rare is the combination of irregular distribution of this vessel with lithotomy. In my own intercourse with the dissecting room, of thirty years, I have not witnessed more than half a dozen examples of it.

Prostatic veins varicose.

Looking to the large size of the veins that occasionally present themselves in the neighbourhood of the prostate gland, as observed on dissection, some considerable bleeding might be expected in this operation, from their partial division. I cannot say that I am familiar with the fact of their liability, however, to become varicose, to which condition their disposition to bleed has been occasionally referred. Should the bleeding continue injuriously, the patient may be brought to an open window, or remaining in bed, the pelvis, divested of clothing, should be raised on a pillow, and a cold cloth occasionally applied over the perinæum. The only treatment adopted for the wound, is that of applying a handkerchief round the thighs, to prevent their being separated.

On being returned to bed, the patient is usually placed on his back. Better, perhaps, to place him on the left side, to facilitate the gravitation of urine, passing through the wound. At this time, unless the operation has been much prolonged, and the bleeding, from accidental circumstances, has been unusually great, he is not much exhausted, and if the incision through the prostate has been of moderate length, the prognosis will be highly favourable. The chief treatment, and that is almost negative, consists in preventing the wound becoming clogged with coagula. If local pain or any sense of distension follow, the wound should be examined, and either a large-sized elastic catheter, or the finger, well greased, should be carefully passed into the bladder.

After treatment.

With respect to inflammation, whether of the bladder itself or of the peritoneum, I would venture to caution the young practitioner against too great apprehension of its probable occurrence, and also against the error of mistaking a sense of general uneasiness, or even of tenderness of the abdomen, consequent on many, perhaps on most, operations of lithotomy, for the signs of true inflammation; and in the occurrence of positive inflammation, to rely rather on the influence of mercury, conjointly with moderate depletion, than on the repeated application of leeches to the abdomen, and general venæsection.

The only important modification of the operation which I shall allude to, is that in which it is complicated with enlarged prostate gland. The fact of this enlargement must have become known prior to the operation. It will be suspected on the introduction of the requisite instruments into the bladder, and confirmed by examina-

Enlarged prostate.

tion by the rectum; moreover, the patient will be advanced in years. The existence of the ordinary enlargement of the gland, even though great, does not admit of any substitute for the lateral operation, however positively it may increase the difficulty of its execution, unless, indeed, the organ is so unusually large in all directions as to preclude the introduction of the staff through the urethra, when we have no alternative but the high operation, or that performed above the pubes.

In cases of ordinary enlargement, the staff should be curved upwards, between the perineum and bladder, or for the last two or three inches. The knife employed should be somewhat larger than usual, and the division of the gland more extensively made; still relying, however, rather on the finger, if sufficiently long to reach the cavity of the bladder, and on the dilating influence of the forceps, to form an opening of sufficient size to admit the passage of the stone. But the staff should not be withdrawn from the bladder, until this opening is effectually made. The operation requires time for its completion. It should be executed with unusual deliberation, under the influence of chloroform. The result of my observation of such cases, whether under my own hand, or that of others, has been favourable to recovery. I have never known a case prove fatal from this cause, and I have witnessed more than one example in which, after recovery, the symptoms of enlarged prostate have entirely subsided.

Operation to be deliberately performed.

With respect to the high operation for lithotomy, I have neither performed nor witnessed it, and I must refer the reader to other more competent authorities for information.

# CHAPTER XXVI.

## ON THE OPERATION FOR PUNCTURE OF THE INTESTINE IN CONSTIPATION, AND FOR IMPERFORATE ANUS IN INFANTS.

Cases of constipation that resist the influence of ordinary treatment by means of purgatives, enemata, &c., are often dependent on mechanical obstruction in some part of the alimentary tube.

Causes.

Such obstruction may be dependent on various causes. First, on strangulated hernia; secondly, on intus-susception of the intestine; thirdly, on the occurrence of an abnormal twist of the bowel; fourthly, on the formation of a bridle of lymph, the pressure of which may insulate the contents of a portion of intestine; fifthly, on the external pressure of malignant tumours; sixthly, on stricture; and, seventhly, on a condition of intestine allied to either spasm or paralysis. Of such causes, the first and three last involve disease of both the large and small intestine; the three remaining are limited to the small intestine only. When the disease is seated in the small intestine, whether jejunum or ilium, the symptoms are more acute and more rapid in their consummation, consequent on their higher degree of vitality than that of the large intestine.

Of the causes above alluded to, hernia and stricture are by far the most general, and on such a case presenting itself for treatment, no sooner does the suspicion of its nature occur to the mind of the medical attendant, than it becomes his duty to examine the regions in which hernia, whether inguinal, femoral, or umbilical, ordinarily occurs. If the examination, when fully made, prove inefficient, the inquiry should be continued in reference to other causes; and of these stricture is by far the most frequent.

Symptoms of stricture.

The evidence pointing to such form of obstruction is generally obtained, first, from the absence of primary inflammation of either the intestine or the peritoneum, of which constipation is a symptom; secondly, from the gradual advance of the constipation, which may have existed in a greater or less degree for many months; thirdly, from the absence of considerable pain on pressure; and, fourthly, from the consciousness on the part of the patient of his inability to act on the lower part of the rectum by the agency of the abdominal muscles. As the symtoms advance, the stomach rejects food, the intestines become distended with flatus, and the bowels writhe in a painful, but unsuccessful, effort to force the passage. These efforts become less frequent and less powerful, till the patient dies exhausted.

Such is the general history of cases of mechanical obstruction to the alimentary canal from stricture, proving fatal to life.

**Stricture more common in large intestine.**

Stricture of the bowel is more frequently seated in the large than in the small intestine, and occupies the rectum more commonly than any other part of the canal. The presence of the disease when in the sigmoid flexure of the colon, may be occasionally felt by pressure on the parietes over the left iliac region. But evidence of its nature must be obtained from every productive source. If the patient be advancing in life, if constipation has been, perhaps for months, even for one, two, or more years, an attendant evil, and the obstruction gradual, yielding only to the daily influence of powerful aperients, or to enemata, if there exist no evidence of recent inflammation, no local pain, we may generally infer correctly that the large intestine is the seat of stricture within the gut, or of pressure without, of scirrhous character. This is not the product of recent disease, of contraction of the canal, from common thickening, the result of inflammation, but from deposition of cancerous matter in the submucous tissue of the intestine, involving the entire structure of the bowel; and it is often in such a case that the opinion of the surgeon may be required, to determine on the feasibility of opening the intestine above the stricture, and to form an artificial anus. The progress of this disease is sometimes remarkably slow. I attended a gentleman in the year 1856, from whom I obtained conclusive evidence that the disease had existed for eighteen years. I knew another example in which its origin might be traced back to seven years.

Motives justifying interference.

The desire to preserve a human life is undoubtedly a very powerful motive in favour of an operation, and if life could be preserved by such means, it is the duty of the surgeon to undertake it at any cost to himself; but we must distinguish between the consequences of an operation that will *prolong*, and an operation that will *preserve* life; in other words, that will effect an absolute recovery. The intestine cannot be punctured without danger to the life of the patient, from the consequences of the operation itself. The mere act of puncturing the bowel entails, perhaps, no extreme danger to life; but it must be recollected, that before resorting to this *anceps remedium*, the patient is necessarily reduced in strength, by the long subversion of the abdominal functions, by the loss of food, and by the agency of remedies employed during many days for the purpose of forcing a passage, both cathartic and counter-irritant. If the operation of puncture be proposed with a view to preserve life, it must be recollected that, in opening the intestine, we leave untouched a malignant disease that will increase, and probably ere long destroy the life that has been temporarily only extended. To leave behind such a disease on the back of a large and serious operation, is not very consistent with scientific surgery, and certainly cannot be recommended, especially when we consider the discouragement given to the cause of operative surgery, by the occurrence of a fatal result, and the loss of confidence entailed on those who are shaken in resolution from submitting to an operation which may present a far better prospect of success. If the puncture be proposed with a view to take the chance of prolonging life for an uncertain term, which, under circumstances, may be of especial value; if the case be clearly and honestly stated to the patient or the friends, as one likely, in all human probability, to become fatal within a given time, say one or two weeks, or a month or two months, for the duration is quite uncertain, then, and then alone, the operation is warrantable.

Disease to be ascertained if possible.

It is important that the surgeon satisfy himself of the nature of the disease, if practicable; but this knowledge can only be obtained with any approach to certainty, when the disease is situated within reach of either the eye or the hand. A great effort should be made to effect this object; and when seated in the lower part of the rectum, by far the most frequent situation, its presence may be detected by examination. When the finger, well greased for the purpose, is introduced into the intestine, we observe the presence of a more or less capacious sac formed by the dilated bowel, immediately within the sphincter. In cases of many years' standing, this pouch is very large, and will permit the finger to be turned round in all directions, without being brought into contact with the walls. When the finger is directed backwards towards the coccyx, we find more or less high, for it is generally within reach of the finger, a hard swelling situated in the texture of the bowel, and from which is felt a projecting nipple-like process, depressed in the centre to a size that would barely admit the point of the little finger. This is the nearly occluded orifice of the bowel. If the disease assume this character, we may at once abandon the hope of benefit from an operation undertaken for any other purpose than that which contemplates a possible and temporary extension of the term of life.

When warrantable.

Such an attempt may become warrantable for various purposes, such as the distant absence of a relative or friend, in an interview with whom something more than affectionate interest is involved; for how much of the future happiness of a surviving individual may not depend upon the confidential communication made on a bed of death? or again, the distribution of property may be involved to a large extent, which may be diverted from its legitimate channel, or may be acquired, should the patient survive to a future day beyond which an operation might in all probability carry him. If life, under such circumstances, is desired by the patient and his surrounding family or friends, I do not think a surgeon should hesitate in refusing the benefit of his co-operation, whether the motive be founded on moral feeling and affection, as in the case of absent relatives, or on the question of property. With respect to the operation itself, the first question relates to the locality, and here it would appear desirable that that region should be selected in which the intestine is most readily punctured.

Kind of operation.

Other considerations, however, occur to interrupt a hasty decision on this head. The intestine may be exposed in the left lumbar region, as in the operation for tying the common iliac artery; and looking to the future comfort of the patient, and the nature and office of the opening about to be made, this region has advantages possessed by no other attainable one. But it must be recollected, that the colon in this situation lies at a distance from the surface, and that a puncture into it could not be made in safety without careful and prolonged dissection, and that a tube so introduced must be necessarily retained along a deep and suppurating wound, whereas an opening in front is made through thin parietes and into a distended bowel, the outlines of which are apparent to the eye. I think we ought to lay aside all considerations of future comfort for the sake of the important question of temporary safety. If the disease be uncertain in its nature, and present a reasonable prospect of ultimate recovery, that situation should be preferred which offers less objection on the ground of comfort and cleanliness; but in the example above given, every other consideration should be sacrificed to safety, and I conceive that there can be no doubt raised as to which locality the preference should be given. It is true that the front surface of the body is more highly organised, and that operations on the back are less serious in their consequences; but this is not a question involving parietes without, but organs within; and if the intestine has to be opened with a view to form an artificial anus, I conceive that the lower the puncture be made the better, not merely with regard to the length of the remaining tube, but with that of the vitality of the intestine itself.

**Lumbar region.**

As regards the mode of puncture, if made through the anterior wall, that point should be selected which indicates the greatest degree of prominence of the bowel, which in such cases is always both dilated and thickened by its long expulsive effort. The ear and the stethoscope should be brought into requisition, and the outline of the bowel well ascertained by percussion. The integuments may be divided to the length of an inch or more, and the abdominal muscles cut asunder to the extent of the outer wound. A large curved chain trocar in a canula, with the point directed upwards along the tube,

**Mode of puncture. Anterior operation.**

should be introduced quickly into the bowel, and the canula retained during the escape of the contents, and, indeed, so long as local disturbance does not ensue. The canula should be of such length as to prevent its escape from the bowel, as the contents flow off, and the gut contracts in diameter.

Lumbar operation.

In the operation on the intestine in the lumbar region (Amussat's), the external incision should be made from the point of the last rib downwards, towards the crista ilii, the muscles should be divided to a less extent, and the bowel punctured with a long straight trocar, the canula of which should be retained on the same terms as in the operation in front. The necessarily greater extent, both on the surface and in depth, of this operation, is the chief element among the objections to its performance.

## ON IMPERFORATE ANUS.

Examples of infants born with imperforate anus are not uncommon. The presence of this defect of healthy development is not observed until, after the expiration of many hours, the attention of the nurse or mother is attracted to the absence of meconium. It may be, attributable to the want of ordinary care and observation on the part of the nurse, that three or four days (I have known a yet longer period) have elapsed before the discovery is made, that the orifice of the bowel is closed, and the escape of its contents rendered impossible. At such a period from birth, the abdomen of the infant becomes distended and prominent, and the repeated efforts to expel its contents occasion more or less evidence of exhaustion. Under ordinary circumstances, one or even two days elapse before the condition of the child is detected, and the real cause of its condition explained. Surgical aid is then eagerly sought. On the presentation of such a case, the surgeon will bear in mind the certainty of a fatal issue, should he fail to establish the continuity of the intestinal tube by operative means. The indispensability of an operation leaves him no alternative, unless, indeed, he is content to throw off the responsibility he accepted with his diploma, and to abandon the child to certain death. Having explained to the mother or other attendant the nature of the difficulty he has to encounter, he proceeds to examine it.

Varieties.

This defect presents itself in three degrees of extent: first, the orifice of the anus may be closed by a membrane more or less thick, against which, on the application of the point of the finger, the pressure of the contents of the intestine may be distinctly felt, either on the spontaneous contraction of the abdominal muscles, or on sudden pressure over the abdomen applied by the hand; secondly, the canal may be defective to the extent of the depth of the sphincter muscle, or about half or three-quarters of an inch, and in which case the impulse, whether from the action of the expellent muscle, or that derived from the sudden pressure of the hand, is either barely, or not at all, perceptible; and, thirdly, the intestine may be defective to the extent of one inch or more. This condition of the tube has all the appearance of absolute obliteration, the bowel terminating above in a cul de sac. In this example, impulse from within is, of course, out of the question.

Operation.

The surgeon takes his chance of these varieties, in the hope that the case before him may at least not belong to the third. The child is laid on its back on a pillow or soft cushion, and brought to the edge of a table. The finger, previously oiled, is applied to the point corresponding with the natural orifice, and the other hand laid open on the abdomen. On making pressure above, if the impulse is not conveyed to the finger, it is clear the defect of organisation does not belong to the first variety. Should it do so, all that is required is to divide the membraneous substance with a common scalpel, when the meconium will instantly escape. If to the second variety, an incision with a fine scalpel should be made vertically, through the entire of the surface, marked by discoloured skin. The little finger, the nail of which should be closely cut, should be introduced into the wound, and impulse detected by the same means as above described, if possible. Should this evidence fail, the knife may be again introduced, in an exactly straight line from the orifice, to the extent of about three lines, and an incision in the vertical direction, both upwards and downwards, made to the extent of the outer wound. Should this proceeding fail to communicate with the intestine, or to bring the finger again introduced within the range of impulse from above, the knife should be laid aside, and a large hydrocele trocar with a lancet point and flattened canula substituted. With this instrument we proceed literally to explore. Having determined the depth to which we will at once proceed, the thumb-nail is firmly fixed upon the canula, and having taken a renewed observation of the pelvis, and the probable direction of the intestine in its normal condition, having recalled to our recollection that the bowel passes straight backwards, eventually inclining *slightly* to the left of the child, we pass in the trocar and withdraw the canula. This failing, provided that the instrument has perforated the substance to the extent of not more than six or eight lines or two-thirds of an inch, the trocar should be again introduced through the canula, and carried to the depth of a full inch or more, care being taken after each renewed puncture to withdraw the trocar from the canula. If the depth of about one inch and a-half has failed to produce meconium, the canula should be withdrawn, and the direction of the trocar changed by carrying the puncture a little to the right or left.

If our efforts are successful after a repetition of the deep puncture, the canula should be forced somewhat farther into the intestine, and retained by silk thread, tied around it, by four ends, two of which should pass forwards and two backwards, all four of which should be fixed to a bandage tied around the abdomen. However satisfactory the operation may prove, both to the parent and the surgeon, the difficulty is yet in front — the real difficulty, which consists in retaining the tube of the intestine in a patent condition, for we must recollect that our perforation has not passed through intestine composed of healthy and normal structure, but through tissues alien to the structure of the bowel. Moreover, it is highly probable that we may not have punctured the intestine at the extremity of the cul de sac, but at the side, and especially is this probable, if we have employed an ordinary trocar of three sides, or have been compelled, from the imperfection of the instrument, to resort to force in its introduction. All we can do, however, is to employ the best resources we can command; and with this view the canula should be withdrawn and a larger instrument, if attainable, of metal be selected, and every effort made to retain the artificial track as patent as possible. In this lies the real difficulty under nearly all conditions of this form of defective organisation. Should our best efforts have proved unsuccessful, if the trocar has sought the bowel in two or three directions to the depth of about one inch and a half, we must reconcile ourselves to the disappointment by the conviction that successful puncture often terminates in closure of the wound and death. We do but convert the imperforate into the artificial anus.

## CHAPTER XXVII.

### REMOVAL OF CICATRICES, AND AUTOPLASTIC OPERATIONS.

The principle of the operation invented or practised by Taliacotius, when resorted to with judgment by the operating surgeon, constitutes a very valuable resource against deformity of various kinds. The notorious indisposition on the part of nature to the reformation of structures identical with those which have been removed by disease or accident, under which law the skin appears as a pre-eminent example, renders the operation of Taliacotius the occasional agent of benefit, by which many persons are rendered capable of being restored to society, and of being relieved from very severe forms of wound, if not of physical suffering. This principle consists in transferring healthy integument to fill a space in which it has been lost ; and although the principle is scarcely maintained in the examples in question, yet the term is equally applied to the junction of fissures occurring in the mesial line of the body, whether the result of accident, of disease, or of congenital deformity. On the Taliacotian principle, more strictly applied, we perform the rhinoplastic operation, that of the formation of a new lip or new eyelid, and also that which attempts the restoration of the external outline of the body, by the substitution of new skin after the destructive action of burns. Under the same title, somewhat incorrectly applied, we perform the operation for staphyloraphy, or velo-synthesis, or hare-lip, and that for union of the lacerated perinæum in women.

Nature of the operation.

Burns on the face.

It will readily be granted, that no disease, or no description of deformity, to which either youth or age is subject, can be more distressing, and I may say more revolting, than the occasional destruction of the human lineaments by fire. Occurring in early childhood, these unfortunate sufferers, after the sacrifice of one or two years to what is termed their recovery, present themselves at our public hospitals with the total loss of the anterior integument of the neck and lower portion of the face. The chin is adherent to the sternum; the chest and face are seamed with old scars; the lower lip is drawn downwards into permanent eversion, giving the appearance of continued protrusion of the tongue. Two or more bridles, of from one to two inches in depth, run down from the face to the front of the chest. The growth of the lower jaw and its appurtenances is arrested, the lower teeth project; the lower eyelids expose the hollow of their concavities; the mouth itself is concealed from view by the lateral bridles of skin, which are rendered still more prominent, whenever the attempt is made to raise the head by the action of the muscles at the back of the neck, and saliva unceasingly flows from the mouth. The entire face participates in the distortion.

**Extent of deformity.**

Before the operation, an instrument should be made to fit on to the neck, for the purpose of raising the chin, which it must support at the symphysis only, because all the base of the jaw may be the seat of operation, except at the centre.

**Principle of treatment.**

In these severe forms of injury, the partial success usually awarded to our best efforts, greatly depends on the healthy condition of the subject, and on the natural activity of the healing process. There is no difficulty in obtaining sound skin by autoplasm, to supply the deficiency, and to fill the space caused by the division of the bridles; but the real difficulty consists in effecting its junction with the diseased parts, and in retaining its vitality, for the base of the wound so made is not to be deemed healthy, but on the contrary, is greatly indisposed to co-operate with the skin laid down, and to accept of its union. It would appear that the vital force of this structure is too much exhausted, in the struggle against the necessary agents of extension, to participate in the healthy actions requisite for adhesion to the structure brought into apposition with it; and when we consider the adventitious nature of this tissue and the probable condition of its vessels, the failure of these operations is not surprising; but this failure is by no means necessary or universal.

**Health indispensable.**

**Taliacotian principle not often successful.**

Since the year 1840, I have treated cicatrices on a new

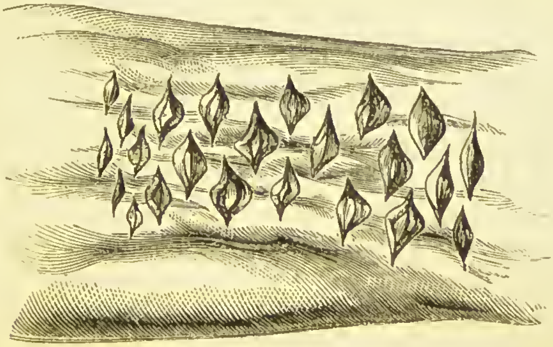
**Operation.**

and as it appears to me, both theoretically and practically, on a sounder principle than that in general adoption. It is based on what I believe may be deemed an axiom in surgery, viz., that *the contraction of wounds is slight in proportion as the time consumed in the healing process is short.*

It is well known to all surgeons who have had frequent opportunities of observing the process of the healing of large wounds, that the rate of their progress towards cicatrization, is slow as they approach their final closure. It would appear, that these actions become exhausted by time; and it not unfrequently happens, that the final closure of the wound may severely tax the ingenuity of the surgeon to accomplish it. The time occupied in the healing process, is in an increasing ratio great with the magnitude of the wound. As a general rule, no doubt subject to exceptions, nearly as much time is required in a wound of four inches in diameter to perfect the healing of the last inch, as is required to complete the process of healing of the first three inches.

A large wound involving the whole front of the neck, whether caused by a burn or made by the knife of the surgeon, will commonly require a period of many months, and even of a year, for its complete obliteration. The process involves, not the skin alone, but the cellular structures beneath; and from the beginning, but more especially towards the end, the process of contraction becomes more and more positive and uncontrollable. Its influence on surrounding parts is unremitting, and with a steady untiring force it draws all the adjacent textures within the focus of its influence.

There is another principle involved in the treatment I am about to suggest, which refers to the well-known fact that all exposed wounds, with rare exceptions, heal from their margins only. The exceptions are found in chronic forms of large phagedænic ulcers, in which we often find insulated points of cicatrization extending their influence towards the circumference of the sore. If in the performance of an autoplastic operation, we make a wound of two inches square, we have a healing margin of eight inches. If instead of a single wound of two inches square, we form four wounds, each of one inch square, a healing margin of sixteen inches square is the product. In like manner, if we subdivide the wound of two inches into sixteen yet lesser wounds each of one quarter of an inch in diameter, we produce to the entire wound a healing margin equal to the square of 16, or 256, and so on. Still this calculation is not strictly speaking correct, because it is of course necessary to the principle itself, that a thin line of integument competent to generate the process of cicatrization be retained around each lesser wound, and I am not prepared to say to what degree of tenuity this line may not be reduced, but I have little doubt that the diameter of one-tenth or even of one-twelfth of an inch would suffice for the purpose. If, therefore, instead of exposing large surfaces we subdivide them by a number of minute divisions both of the skin and subjacent tissue, we obviate in a great measure the evils inseparable from the larger operation, by increasing the ratio of circumference to that of the area of each wound. The incisions should be made with a small, fine-pointed scalpel, their average length extending from one-third to two-thirds of an inch. The division of the skin alone is not sufficient, but should extend to the cellular tissue beneath it, which should be freely divided to the full extent of the outer wound. If the band be broad, it may require two or more incisions in the same line. But whatever be the number, whether one, two, or three, the centre of the incisions, both above and below, should nearly correspond with the intervals between them, and not with the incisions themselves, so that when completed, and the textures drawn out in sufficient extension, the aspect of the part presents much the appearance of



the ornament cut in paper by children, and termed a Jacob's ladder. Care should be taken by steadying the surface to be divided with the thumb of the left hand, to prevent the incisions running into each other.

Practically, the results of this treatment fully bear out the theory on which it is based. To say that its application to the cicatrices of burns merely abridges the period required for the cure of the deformity, is to award a spare and meagre acknowledgment of its advantages. I have on many occasions myself witnessed the time usually occupied in the healing process reduced by this method of treatment from months to weeks, and from weeks to days.

Cases.

In the course of the summer of 1857 I treated a case of cicatrix on the neck and chest of a young girl in St. Bartholomew's hospital. The contraction was large, and the bands rigid and firm. The deformity, though painful to witness, was less than in many cases admitted in the London hospitals. I made eighteen lesser wounds in place of one large one. I placed the girl on full diet, and gave her bark largely. In five weeks she left the hospital as thoroughly cured as the circumstances of her case permitted. The old scars remained, but the movements of her head were free and unconstrained. I have repeated this operation both on the neck and on the arm, with results nearly as satisfactory and conclusive as in the above case. I have at present under my charge in St. Bartholomew's Hospital, a man whose left thumb was held by a broad bridle of integument in permanent abduction. In his case I made twenty-three incisions in alternate lines, and varying in length from one-third to two-thirds of an inch. The relief is perfect.

After-treatment.

With respect to the number of the sections to be made, we should be guided by the extent and freedom of movement obtained. The restraint should be entirely removed if possible, beyond which additional sections are needless. The renewed contraction during the brief period of cicatrization, will be scarcely perceptible. With regard to local treatment, there is no necessity to attempt to hasten the healing process. Cotton wool may be applied to the surface after the operation, and the part maintained in a state of fixed extension, till the healing process is completed. If the integument around exhibit the appearance of inflammation, or so much of inflammation as is denoted by local pain and redness, and the wounds become dry, I have found a poultice applied during forty-eight hours, sufficient to restore the parts to the aspect of health, on the removal of which the wounds may be treated with adhesive plaster drawn moderately tight over them. Pressure is often required for the purpose of obviating the liability to burrowing caused by the tendency of the agent of extension to draw the integuments mechanically off the surface beneath it.

Rupture of perineum.

In the act of parturition, either caused by the unusually large size of the head of the child, or by the neglect of the attendant to afford sufficient support to the perineum, rupture of the part occurs, and the orifices of the vagina and rectum are mutually involved in one common opening. If the separation be limited, the evil is not very great, and the sphincter ani retains much of its power over the intestine: when considerable, the separation is large, all the cutaneous sphincter is involved, and a greater or less portion of the larger muscle surrounding the intestine. The inconvenience and discomfort are then very great, arising from the inability by the patient to retain the contents of the rectum; and such an evil, to a delicate woman, is little less than the loss of life itself, for she is debarred from society, and almost from any ordinary exercise. Operative surgery has too often failed in the attempt to restore the integrity of the divided structures, to justify a hope of success, except under circumstances of peculiar care on the part of the operator, and the most favourable condition of health as regards the patient. But so much depends on success, as it involves the future comfort, happiness, and even the health of the subject, that the best means should be resorted to, to remove the evil. Success will, however, rather depend on the collateral than on the direct management of the surgeon, on the time selected, and, most especially, on the condition of health of the individual. It is not desirable to undertake this operation during lactation, and particularly so if the quantity of milk be obtained only by means of stimulating food. If the quantity be ample, without effort, the objection is lessened. A tonic and healthy circulation is requisite for healthy local actions, such as are required for the healing or uniting process, fresh air, and a

Degree of injury varies.

Collateral agents.

Condition.

capacious chamber. These conditions, if not indispensable to success, are important ingredients in obtaining it.

Action of the rectum to be controlled.

But perhaps the most important consideration connected with the subject of perineo-synthesis relates to the management and control of the expulsive power of the rectum. However perfect may be the temporary union obtained by the operation, it will prove insufficient to contend against the more powerful effort on passing the contents of the rectum, the force of which is directed so entirely against the wound. Indeed, the management of the bowels may almost be said to be the great difficulty of the undertaking. If the bowels are considerably relaxed before the operation, it cannot be said that the patient is in the most favourable condition for sustaining it, and yet any expulsive effort made during the healing process is almost sure to separate the uniting parts. This, therefore, is a part of the subject worthy the best care and consideration of the surgeon.

The large intestine should be entirely emptied by enemata, rather than by medicine taken by the mouth. By this means no draught will be made on the circulation, and the patient will enjoy her ordinary health.

Too large a union not to be attempted.

The surfaces should be sufficiently pared of integument, be it ordinary skin, or the compound of skin and mucous membrane, which forms in the torn structure, to bring into contact a substance sufficient to ensure strength both in surface and in depth; but too much should not be attempted. One half of an inch of union will remove the evil; but to attempt the junction of parts very largely, and most especially if carried beyond the natural line of junction, into which error inexperience may readily lead us, is to encourage failure in the result. The parts being pared of integument, the quilled suture is employed, and for which purpose the needle should be passed at a distance of half an inch at least from the margin, and carried down nearly to the bottom of the wound, in order to unite it fully to its base. Two ligatures may include the quill or bougie, or whatever material be employed, and a third thread may still be required. There is no advantage in the lateral incisions, simply because there is no strain on the wound in any position of the body. A day and a half, or two days, should be allowed to elapse before the action of the bowels be permitted. If longer, the effort required, and the consequent strain on the wound, will be greater. Assistance should be given by one or two nurses in the act, by lateral pressure of the hand.

Parts to be kept dry.

Of the two conditions, a state of relaxed bowels throughout the treatment is preferable to constipation, for nothing can withstand a violent expulsive effort of the abdominal muscles and rectum conjointly; but the latter condition is far more favourable to union. It is important throughout the treatment to keep the vagina as dry from secretion as possible, in order to prevent its contact with the wound. This should be effected by the constant application of dry lint, or any similar and suitable material.

Recto-vaginal and Recto-vesical fistulæ.

Cases of great interest frequently occur of artificial openings between the vagina and rectum, and between the intestine and the bladder; as also between the rectum and urethra, in the male subject, known under the terms recto-vaginal and recto-vesical fistulæ, &c.

The frequent want of success resulting from the attempt to obliterate these and similar abnormal fissures, is dependent on various causes; but chiefly on such as arise from the mechanical difficulty of perfecting the operation itself. The inaccessibility of the wound, its depth from the surface of the body, the indurated margin around it, and the paucity of the material we can command, added to the limited experience of such cases as is allotted to the large majority of operating surgeons, qualifies very much the success that occasionally attends the best devised efforts made to obtain it. Still the attempt must be made, if we would employ the resources of curative surgery, to the purpose of removing, not merely a deformity which applies to the restoration of external form; but a defect in the internal organism, which is not only fatal to the comforts, and to many of the pleasures of life, but is more or less injurious to the health of the subject of it. The conditions favourable to success may be enumerated as follows:—A small aperture in an accessible situation—of recent formation—and occurring in a healthy person. The opposites of these conditions, viz., a large fissure, of long duration, placed at the distance of from one to two

Favourable cases.

inches above the sphincter ani, would constitute a case of difficulty proportionate to the affirmative character and positive nature of the above conditions. With a reasonable amount of success I have performed these operations, on both male and female subjects; and I can only lay down such general rules as appear calculated to afford the best promise of a fortunate issue. In comparing with each other the two operations for recto-vaginal, and recto-vesical fistula, we find increased difficulty in the latter operation, caused by the contraction of the sphincter ani; while in the former, the greater dilatability of the vagina removes in some measure one difficulty of the undertaking. As the operations are the same in both examples, I shall refer to that performed for recto-vesical fissure. The first condition is health, without which we operate at a disadvantage. Any reasonable time should be devoted to this object. The second condition relates to a complete command of the orifice of the fissure. This can only be obtained by the free employment of the speculum ani. For this purpose, the patient should be placed under the influence of chloroform, and the sphincter largely dilated, by the speculum, of which the instrument composed of three narrow blades is perhaps the most efficient for this purpose. Before proceeding to operate, it is desirable that the orifice of the fissure be carefully scrutinised by the aid of light, as perfect as it can be obtained, whether natural or artificial, both by the eye and by the finger. If of long standing, the textures around it will be firm and rigid to the touch, on the union of which we could not safely rely under the presence of any unexpected difficulties in the after treatment. Supposing the health good, and the contents of the bowels recently and freely evacuated, the edges of the wound should be pared by means of one or more small and fine-bladed knives, placed at different angles with the handle, and with the peculiar and requisite movements of which the surgeon should have previously rendered himself familiar. The incision should involve as much of the substance, forming the walls of the fistula, as is compatible with safety. The orifice may be held either by means of a fine double hook, or by a small vulsellum. If the edge is merely drawn forwards at the centre,

Operation.

supposing it one-third of an inch in length, the incision will be imperfectly made; and hence the objection to the single hook. When the two edges with the deeper material forming the walls of the fissure, are excised to a thickness sufficient to remove the harder deposit around, to the extent probably of about one-eighth of an inch, the needles are introduced. Many ingenious instruments have been invented with a view to simplify this stage of the proceeding; but I doubt whether the success has proved commensurate with the ingenuity of the invention. I prefer what I believe will prove a more generally efficient instrument, viz., the simple needle—very small and much curved. If this instrument armed with fine silk, be held at a suitable angle, by the aid of the needle forceps, it may be passed through the edge of the wound without great difficulty, supposing the margin to be held by means of a pair of fine forceps very long in the blade, and incisor toothed at the extremity. If the blades of the needle forceps be lined with soft leather, they will with greater readiness grasp the needle in the transverse axis. The needle being withdrawn, the point is carried behind the opposite side; and with a little careful manipulation is brought forwards to the surface. A second needle will in all probability be required; and it should be introduced before the first is fastened. This may be done by means of a knot held by fine forceps, or by the aid of a perforated ring of lead pushed along the two threads up to the wound, and flattened with pliers.

Another mode of carrying the threads through the margin of the wound has been described in the operation for cleft palate.

With respect to the action of the bowels, it is obvious that the force of muscular action incidental to it, must prove in a greater or less degree injurious; and it should be postponed if possible for two or three days, or longer. This may always be effected by administering a moderately active aloetic purgative before the operation, to be succeeded after its action by an opiate. If this plan of treatment be adopted, it will demand the employment of repeated enemata to ensure the breaking down of the contents of the large intestine as they descend towards the sphincter.

# CHAPTER XXVIII.

## EXTRACTION OF FOREIGN BODIES—ACUPUNCTURE.

We are sometimes called upon to remove extraneous substances from among the tissues. Needles, or portions of them, are often accidentally driven through the skin into the subcutaneous cellular tissue, or deeper textures. They remain embedded for a longer or shorter period, and sometimes for a considerable length of time, causing more or less of suffering, and, on the other hand, occasionally giving rise to no symptoms whatever. Needles, &c., whether introduced in this manner or through the stomach (for portions of needles or pins are sometimes accidentally swallowed with the food), travel about the body in a very remarkable manner, being often detected at very remote spots from that by which they were introduced. Persons occasionally present themselves, complaining of eccentric pains in certain parts, as the shoulder, breast, &c., which are found upon examination, to be caused by the presence of some foreign body under the surface, or being more deeply seated, the cause is not discoverable. They can give no account of the mode in which it came there, or perhaps they remember "breaking a needle in the finger" many months ago.

**Needles travelling.**

**Uncertainty of its presence.**

If we can extract the foreign body without difficulty, we should do so by making an incision over it. This spot is usually indicated by a little circumscribed thickening of the integuments. But we are often baffled in these trifling operations. Such attempts at extraction may appear very easy, we almost fancy we perceive the outline of the substance, but after dividing the skin and pursuing the examination for a considerable length of time, we are compelled to close the wound, having accomplished nothing. We should always hesitate to make an incision through the skin, unless we feel tolerably certain of effecting our object—failure is annoying both to the surgeon and the patient. Sometimes, in the case of a needle, by a little well-applied pressure, we may force the sharp extremity through the skin, and thus extract it without further inconvenience.

**Bullets, &c.**

We are not often required, in civil practice, to extract shot or bullets from the body, but that duty may devolve on any surgeon. Having satisfied ourselves of the presence of a musket-ball, or other foreign body, in any recent case, or if its removal can be effected without increasing the danger, the attempt should be made. We ascertain its presence by means of a probe, or what is far better, by the introduction of the finger, if possible; if it cannot be felt, we must seek for other less certain evidence, such as the existence of an aperture of entrance, and the absence of one of exit; but these signs are fallacious; more than one ball may have entered, or if only one, it may split against the bone, one half escaping, and forming a counter opening, and the other part remaining behind. All contrivances, in the shape of bullet-forceps, &c., for the purposes of extraction, are generally useless. If not within reach of ordinary forceps, the removal of any foreign body will be a matter of considerable difficulty. Bullets sometimes pursue a very remarkable course, being often turned from their original direction, by an apparently trivial obstacle. Dr. Hennen observes on this point that foreign bodies take "routes, not at all to be accounted for by any preconceived theories drawn from the doctrines of projectiles, nor to be explained by diagrams founded upon mathematical rules." With regard to bullet-extractors and forceps, he says, "Unfortunately, we most require their mechanical power in tortuous passages, or deep, curved, and angular cavities, where we can least make use of them."* We may, if requisite, enlarge the wound. This, however, should never be done as a mere matter of course, without some clear and definite object. Dilatation of the orifice is generally necessary in order to facilitate extraction. When the foreign body lies tolerably near the surface, and at some distance from the original wound (but not otherwise), we may cut down upon it. We

**Course of bullets.**

**Incisions when to be resorted to.**

---

* Hennen on Military Surgery, 2nd edition, pp. 75, 76.

are justified under these circumstances in making a second wound. If a bullet be lodged in bone, it may be followed by means of saws, scoops, or trephines. Mr. Guthrie describes the consequences of a ball remaining embedded in bone as generally very serious. Bullets, however, may remain encysted in various parts for many years, without causing any particular amount of inconvenience, and may at last require removal, as in the following case.

Case. A man presented himself to me at St. Bartholomew's Hospital, in the year 1845, and requested that I would remove his leg. He stated that he had received a musket-ball in the left knee, at the storming of Ghuznee, in India; that he had suffered pain in the joint ever since—a period of some four years; that he had no hope of recovery, as all means of relief had been exhausted. On examining his knee, I found a depression, about three inches above the outer condyle, formed by the ball, which had not passed through the limb. When this fact was fully ascertained, I felt much inclined to trephine the bone; but the question at once raised itself, at what point to trephine? Circumstances curiously combined to enlighten me in this inquiry. I had at that time under my care Captain H., the officer who led the storming-party at that siege, on the blowing up of the outer gates with gunpowder, and who was well informed of all the details. From him I learnt the height of the walls from which the soldier was shot, and the distance at which he must have been placed from their base; and by these means I calculated the angle at which he must have been struck, and that the ball, if not diverted from its course, must be deeply sunk in the substance of the inner condyle. This probability was increased by the fact of pain being referred to that region. Under these circumstances, I determined to trephine the bone. For this purpose I had a deep trephine made of about eight lines in diameter, and having drawn a line, forming an oblique circle around the joint from the point struck, I cut down on the condyle at the point crossed by this line. I then applied the trephine, and cut into the centre of the condyle. The bone was harder than it usually is in health, and of this sign I augured favourably. Having removed the centre, at the depth of somewhat less than an inch from the surface, I struck on a metallic body, which proved to be the bullet, and which I extracted with some little difficulty, by means of a strong instrument, on the principle of a corkscrew, which I had had made for that purpose. The man recovered, and retained a useful limb. Doubtless, the success of this operation was greatly due to good fortune, and not exclusively to skill.

The above remarks are merely intended to illustrate the principles upon which such cases should be treated. For further detail, I must refer to the works of military surgeons, as those of Hennen and Guthrie. I cannot learn that our knowledge of this branch of surgery has been at all extended by the late war.

## ACUPUNCTURE.

The practice of puncturing the skin with a needle or fine lancet is sometimes adopted, with a view to permit the escape of serum from the cellular tissue beneath, in cases of anasarca. From six to twelve punctures are generally made in the lower extremity for this purpose, and the quantity of fluid which is removed by this means is sometimes very considerable—much more than might be anticipated. It is advisable not to make these punctures very near to each other. This operation has occasionally been followed by sloughing of the integuments, a result attributed to the too frequent introduction of the needle within certain limits. Hydrocele is sometimes treated in this manner; the fluid escapes into the cellular tissue of the scrotum, and from thence is rapidly absorbed. Acupuncture was formerly much practised for the cure of certain diseases, as neuralgia and rheumatism. It was sometimes combined with galvanism; two needles were introduced to a greater or less depth among the tissues, at a certain distance from each other, the diseased part being included between them, and a wire of the battery was attached to each. This plan of treatment is, at present, I believe, very seldom resorted to.

We often assist our diagnosis of certain tumours by the introduction of a *grooved* or open needle into their substance. The character also of any fluid, the result of disease, may often be conveniently ascertained by the introduction of this instrument into the cavity containing it. A small quantity usually escapes along the groove, or if the fluid be too thick or viscid to pass through the small aperture, we withdraw the needle, after rotating it, and generally find a sufficient quantity remaining in the groove for the purposes of diagnosis.

The introduction of a needle can scarcely be termed an operation. It is passed through the skin by a slight jerk, and carried onwards by gently rotating it. The resulting aperture seldom needs any subsequent attention.

Fine trocar. It is sometimes preferable to employ a very small lancet, or the fine trocar, which latter is an instrument often of value in perforating the walls of cavities.

When we call to mind the uncertain nature of diseased fluid products formed within the body, which no tact, however erudite, can invariably determine, and recollect how entirely the treatment by the surgeon, in many cases, should depend on an accurate diagnosis of the nature of such contents, no prudent man will be unprovided with some form of instrument of this kind, which will answer the useful purpose of exploring many diseases of doubtful character before proceeding to extirpation. Its introduction is productive of little pain, and I cannot say that I have ever known an example of injury sustained from its judicious use; while, on the other hand, its employment is occasionally the source of the greatest delight both to the patient and to the surgeon. Of the value of such instruments, whether in the form of a grooved needle or of a minute trocar, I will give one example

Case. that occurred in my own practice; ordinary examples are familiar to us all. Several years ago I was consulted by a gentleman, formerly a member of our profession, who was enjoying in private life the reward of an active and honourable career of laborious devotion to his profession, during which he had deservedly acquired the esteem and affectionate regard of a large circle of his friends. He is yet well known in the county of Berks. This gentleman had a swelling of the cheek which appeared to arise from the bone. The swelling involved the side of the face, was firm in substance, and rounded in form. It was not attended with much pain, and in size was equal to that of the section of about the half of a moderate sized orange. It had much the appearance of malignancy; in which direction the opinions of Mr. ——, of myself, and of another surgeon of eminence who was consulted, gradually pointed. The probable issue was well known to the subject of the disease; and as for myself, I would most willingly have relinquished any responsibility altogether. He had paid me several visits, and each visit rather tended to increase the fear of a malignant disease. After seeing him for some five or six times, I determined to bring the knowledge of its nature to a crisis, and we waited the issue of the inquiry, in silent but most painful apprehension; and I need hardly say, that the moment that decided, whether a man with the high qualities I have described, should enjoy prolonged life, or be consigned to an early and most painful death, was, as it ever must be, a moment of intense interest. Pus, however, issued from the groove, and all anxiety ceased. Such moments are among the highest resources of the medical man, and afford him some reward for years of unrequited labour and anxiety of mind, that no money can purchase, and no reward can compensate. The above case proved to be an infiltration of matter in the masseter and neighbouring muscles.

Drilling.

A modification of simple acupuncture, which may be termed *drilling*, is often most advantageously employed in hydrocele. It consists in introducing a common sewing or darning-needle as in acupuncture, but instead of immediately withdrawing it, it is to be rotated between the thumb and forefinger for a minute or so. One puncture is sufficient. This simple expedient will generally suffice for the complete removal of the fluid in the course of a few days.

# CHAPTER XXIX.

## ON THE CÆSAREAN OPERATION AND OVARIOTOMY.

CASES REQUIRING THE CÆSAREAN OPERATION — THE MORAL LAW OF ENGLAND DEMANDS THE PRESERVATION OF THE MOTHER — CASES FOR EMBRYOTOMY — OPERATION BEFORE THE FULL TERM OF GESTATION CONSIDERED — OPERATION BEFORE LABOUR HAS BEGUN — TEMPERATURE OF ROOM — CHLOROFORM — OPERATION — AFTER-TREATMENT — OVARIOTOMY — NATURE OF DISEASE — DIAGNOSIS IMPORTANT — UNILOCULAR CYST — MULTILOCULAR CYSTS — VARYING CONTENTS — INDICATIONS FOR OPERATING — CONTRA-INDICATIONS — OPERATION — AFTER-TREATMENT.

THE name of this operation indicates its antiquity. But, notwithstanding its antiquity, it is an operation so rarely undertaken, that few surgeons, indeed, can be said to be possessed of experience in its performance. The Cæsarean operation is resorted to in cases of labour, in which the transmission of the child, in any condition, through the lower aperture of the pelvis, is rendered impracticable, by reason of the contracted nature of the aperture. The completion of the labour must not be simply difficult, but impossible. All the resources of modern art, and all the improvements of manipulative skill, must be proved incompetent to extract the fœtus, even though reduced to fragments within the cavity of the uterus. But this reduction is itself impracticable. Hours, and even days, of actual labour elapse, and no advance is made in the descent of the fœtus. The bones present an impassable barrier to the advance of the function, and the mother dies exhausted, or the uterus bursts in the repeated efforts to expel its contents.

Contraction of pelvis congenital or recent.

This condition of the pelvis may exist in early life, and be coupled with general rachitis of the osseous system, or may supervene on some change in the health of the woman in after-life, and limited to the pelvis only. It is not uncommon in the records of such cases, for a woman to bear a child, which is expelled without difficulty, and within two or three years, to undergo such alteration in the form of the pelvis, as precludes the possibility of natural birth. This morbid condition consists in the contraction in the natural dimensions of the antero-posterior diameter, and is caused not by the approximation of the coccyx to the arch of the pubis, but by the descent of the sacrum towards the symphisis. The approximation is so great as to preclude the free introduction of more than one or two fingers into the vagina. The finger comes into almost immediate contact with the promontory of the sacrum, and the antero-posterior diameter is reduced to a length of from one to two inches, while that of the transverse may remain unaltered.

Question of embryotomy.

The first and most important consideration relates to the possibility of extracting the fœtus piecemeal, by the operation of embryotomy, for the life of the mother is our first consideration. Such is the moral law that guides our British practice. Not so imperative, however, is this law on the continent; nor, indeed, was it in the earlier period of our own country, and hence the more frequent recurrence to the Cæsarean operation in foreign countries. This, however, is the just and prevailing law of England, in which we have recourse to this large and dangerous operation so rarely; and such, perhaps, is the explanation of the fatality that attends it, inasmuch as the disinclination to resort to its agency may explain its unnecessary postponement, until the strength of the patient is too far exhausted to sustain the operation without additional danger.

Statistics of Dr. Kayser.

In the Statistical Records, by Dr. Kayser, of Copenhagen, the Cæsarean section had been performed, up to the year, 1839, no less than three hundred and thirty-eight times since the year 1750; of which cases one hundred and twenty-eight recovered.* Many examples are recorded of recovery from the operation repeated on the same woman. Dr. Michaelis, of Kiel, operated three times successfully on the same subject. An example is also related of success attending its performance four times on the same woman.† When we hear, however, as in the statement of Dr. Hœbeke, that the operation has been performed no less than fifteen times by the same operator, we may reasonably inquire, whether all the resources of modern art were exhausted before having recourse to the section of the uterus. With respect to the facility of removing the fœtus by means of the operation of embryotomy, there is no doubt that it is possessed in different degrees of perfection by different accoucheurs; for success does not more depend on manipulative skill than upon the exercise of patience, and the endurance of both fatigue and trouble by the accoucheur, as well as of suffering by the patient. The difficulty of obtaining a free access to the uterus for this purpose, may, independently of the contracted state of the pelvis, derive increased difficulty from the condition of the cervix.

---

* British and Foreign Review, vol. xiv.

† Edinburgh Med. and Surgical Journal, vol. xlvii.

Relaxation of cervix.

In a case I shall afterwards relate, of deformity occurring in early life, in which the cervix was jammed in between the bones, the lower part of the organ did not participate in the general actions of the remainder, but continued flabby and undilated up to the moment of the operation. This fact, supposing it a general one, should be kept in mind, as likely to distinguish the cases of contraction from congenital deformity, from such as had occurred in later life, and especially from cases requiring the operation on women who had previously produced one or more children by natural birth. In such cases I imagine that the operation by embryotomy would be impracticable, unless by division of the cervix uteri, which would render the undertaking so complicated as to influence strongly the decision in favour of the larger operation.

It is obvious that no absolute rule can be laid down applicable to all cases of questionable necessity. It is equally so, that an antero-posterior diameter of one inch is incompatible, either with the descent of a full-grown fœtus, or with the manipulation required by the embryotomist. Therefore, in such a case, we resort at once to the Cæsarean operation ; while, on the other hand, supposing the diameter to be that of two inches, its necessity then becomes a question. In my first operation, performed in 1847, this diameter by admeasurement after death, on removing all the soft parts, was one inch and one third, and when we occupy a portion of this space by the uterus, with its double wall, the bladder, and the

Degree of contraction.

cellular membrane, I may give the real breadth as not more than one inch. And yet in this case there were not wanting in the examination, authorities, if such they may be called, who deemed the operation for embryotomy all that was required. This is human nature and quite unalterable.

In reference to the operation of embryotomy, we must recollect that we are engaged in the endeavour to extract the fœtus from an organised, though by no means a highly sensitive cavity. Under many conditions of eccentric birth, the uterus is the subject of very rough and often of violent handling, of which inflammation of a serious character is no infrequent result. But how much greater violence is sustained by this organ in case of protracted embryotomy, in which large and ponderous instruments are introduced again and again, through a period of many hours' duration, during which, although there may be no escape of blood, the nervous system of the patient is tried to the utmost verge of human endurance. Yet it cannot be denied, that this painful operation is preferable to the alternative of the division of the uterus. Such, however, are the responsibilities of the case, that few medical men would undertake them without the conviction of their absolute necessity, and in cases admitting of doubt, every available authority should be consulted.

Early resort desirable.

With regard to the question of time, the earlier its performance the better, after labour has actually commenced. No doubt, the fatal result in many cases may be attributed to the exhausted condition of the patient before the operation was resorted to. Days and nights have elapsed during which the indecision of the surgeon has failed to appeal to the only resource admissible, and the patient has either sunk immediately under the loss of blood, or life has been prolonged for a few hours only.

Question of operation before the ninth month.

When the condition of the pelvis is ascertained at an early period of gestation, a question may arise as to the expediency of the attempt to forestall the usual date of delivery by an early operation. Such a question was raised on my first case, of which the following are some of the particulars, extracted from notes taken at the time:—

Cases.

On the 25th of November, 1846, Mr. John placed under my charge the case of Sarah Bartlett, aged thirty-two, four feet one inch in height. She was a member of a tall family, but had ceased to grow from seven years of age. She was in the seventh month of pregnancy. Mr. J. informed me, that he had examined her *per vaginam*, and had ascertained the impossibility of her producing *per vias naturales*, a child, even at that period. This opinion having been confirmed by other authorities, I took her into the hospital, and by the kindness of the Treasurer a private room was awarded to her. Shortly after her arrival, she was examined by my friends, Dr. Rigby and Dr. Smith, in conjunction with Mr. John, himself no weak authority in obstetric matters. These gentlemen ascertained, that the antero-posterior diameter was not more than about an inch and a half; that embryotomy was impracticable, owing to the contracted size of the superior inlet to the pelvis, and the proximity of the promontory of the sacrum to the os pubis. I also ascertained the same facts by examination. The patient being placed under my charge, the first idea that struck me was the desirableness of getting rid of the evil as early as possible. The grounds on which I reasoned were these: at the present period, viz., at seven months, the fœtus is small, and the uterus equally so, in proportion. The vessels will bleed less freely, being of smaller calibre. The external wound will be large only in proportion to that required by the uterus. The operation is thus simplified, and has but two objections, viz., that the fœtus of seven months will probably not survive so sudden and unceremonious an introduction into life; and, second, that the woman herself, being at present free from all inconvenience, the operation will come under the class of "operations of expediency." But the woman was unmarried, and had no desire that her child should survive, her own reputation being to herself an object of higher consideration than the life of the child. Having no inclination, however, to become a participator in this sentiment, that argument weighed but lightly on my mind. Yet, in reflecting on the matter, I confess I was inclined to waive all consideration for the child, and to keep my anxieties exclusively for the benefit of the mother.

Grounds for early operation.

However, all my reasoning was subverted by the opinions of others. On this question I consulted Dr.

Locock, Dr. Ferguson, Dr. Rigby, and other eminent accoucheurs, and I also had the opinion of several hospital surgeons. The surgeons, like myself, were generally in favour of the early operation; the accoucheurs of the latter one. The grounds on which the latter formed their opinion were these: Nine months was the natural period of gestation, and at the full term the constitution underwent an important change on reaching a natural crisis; that it would enhance the danger to her life to throw a violent obstacle in the way during the progress of gestation, at that late period of it; that miscarriages, even without violence, were often more dangerous to life than confinements, owing to the above cause; that among the causes of failure hæmorrhage was comparatively a rare one; and, finally, that there would probably be no considerable addition to the quantity of blood lost by an operation at the ninth month beyond that at the seventh.

Opinion of accoucheurs favouring late operation.

The unanimity of this opinion, with the exception, perhaps, of Sir Charles Locock, compelled me to waive my own opinion, though I could not but view, with something allied to alarm, the meandering veins of enormous size, some of which, nearly half an inch in diameter, crossed the uterus, as exhibited in the injected preparation in the hospital museum. Still I felt that the case was a compound one, involving the best resources, both of the accoucheur and of the surgeon; that in all matters relating to the science of the accoucheur, I was bound to be influenced by his experience and his reasoning, so far as it was brought home to my own convictions, while, in the purely surgical department of the case, I early determined to follow the dictates of the best judgment I could myself bring to the case. So far as relates to the matter of experience, however, there was, in fact, none to be had. The position is an unrecorded one; at least I could not ascertain, in any record of midwifery practice, the existence of a case in which these questions had been raised. I place, therefore, before the reader the grounds on which I acted in determining to postpone the operation till the full period of the ninth month.

A second important question then presented itself for consideration; viz., whether, on waiting for the full term of gestation, I should operate after labour had actually

Question of operation before labour.

commenced, or select a convenient hour before labour pains were positively established. The advantages of the latter course were great. I could select the hour, and could not be taken by surprise; the patient could be prepared for the effort up to the hour of the operation; I should be able to command any assistance, and such requisite attendance as might confer important advantages on my patient. The other alternative was not, however, to be readily disposed of. To what end had I been waiting during two months, and superseding the advantages of an early operation, but that the constitution should be freed from a sudden shock. There could be little alteration in the woman's condition in the course of the two months, unless labour pains had actually begun; unless her constitutional powers were screwed up by necessity for some great effort, of which the operation would form a part. In referring to the cases recorded, I find the operation rarely, if ever, to have been done before labour had commenced. My own impressions, therefore, were confirmed on reflection, that it would prove a less severe shock to her constitution, if I waited till labour pains had begun, and then operated before her strength was impaired by the exhaustion consequent on their long continuance. The statistics of the Cæsarean operation compel us to refer the frequency of death to protracted labour, when the uterus had been struggling against a mechanical obstruction during sixty, seventy, or eighty hours, under which circumstances death occurs in the relation of seventy-five per cent.; and it is an equally important feature in this calculation, that the results of early operations, were as favourable in their issue to both mother and child, as the late cases proved fatal to both, the death of the child being, in the latter, almost certain. By the term early operation is understood cases in which the uterus had been relieved within twenty or twenty-four hours; but within this period the earlier the operation be undertaken the better.

Question of temperature of the room.

Two subjects for consideration yet present themselves before I proceed to the operation itself: the first relates to the question of temperature; the second, to the administration of chloroform. With regard to the first of these, it is urged by some authors, among whom is Dr. Frederick Bird, that the temperature of the room should be raised, as nearly as may be, towards blood heat. His recommendation relates, however, to operations for the excision of ovarian tumours, and not to the section of the uterus. There is an important difference between the two: in the operation for Ovariotomy, the draught on the vital powers is not great, the operation itself is far less serious, and little, if any, blood is lost; but in large operations, involving serious loss of blood, such elevation of the temperature of the room is always injurious, by its depressing influence on the nervous system, and is, in my opinion, to be avoided. The temperature is unnatural, and the respiration is hampered by its intensity. If we avoid cold and study comfort, it is all that is required. A cool temperature is more congenial to the action of the lungs, under almost all circumstances, than a hot one, and, in my opinion, far less likely to provoke evil consequences, whether catarrhal or inflammatory.

**Question of administration of chloroform.**

With respect to the administration of chloroform, I am not prepared to give a very positive answer. In the second operation I performed, Dr. West, accustomed to witness the beneficial effects of this agent in St. Bartholomew's Hospital, entertained strong objections to its administration; but I am not certain with quite sufficient reason. That chloroform prostrates the powers in a slight degree, I fully believe; but in a slight degree only, and it must be acknowledged that the Cæsarean operation cannot be classed among the most painful operations of the surgeon. On the whole, however, I am disposed to recommend its use in moderation.

**Position of placenta.**

With a view to prepare for every contingency, it is a part of the duty of the operator to ascertain, if possible, the position of the placenta. At all events, negatively, that it does not lie over the line of incision into the uterus; and this knowledge is generally to be acquired by careful auscultation. If it appear to be connected to the anterior wall of the uterus, we are prepared for a difficulty, which, presenting itself unexpectedly in the course of the operation, would cause hesitation and possibly alarm.

**Incision in linea alba.**

The above being the conditions in which the attempt to relieve the uterus of its contents should be resorted to, I proceed to the description of the operation. The incision should be made in the linea alba. The lateral position of the uterus in the abdomen, is no excuse for an incision in the linea semilunaris, and the transverse section, without sufficient reason, appears preposterous. It would tax my ingenuity to discover an adequate motive for this form of incision. Its length should depend on the size of the uterus and of the abdomen. Probably from six to ten inches would include the extremes. A part of this line must necessarily be above the umbilicus. Before making it, the outline should be marked in ink, otherwise we have no certain guide to the centre of the abdomen.

**Prevent first escape of intestine.**

In the act of making the first incision and until it is completed, it would be well to request the assistants, of which four in number at least are required, to support the sides of the abdomen gently, with a view to press the uterus against the abdominal walls, for the purpose of excluding the small intestines. The incision should stop short of the pubes, by about an inch or two. Two assistants should follow the line made by the knife, with their hands, compressing the abdominal parietes against the uterus, to prevent the escape of intestine from the wound. Much of the success of the operation depends on this manipulation; for the escape of intestine, not only retards the proceeding very unprofitably, but the requisite efforts made to restore and to retain the intestine within the abdomen are necessarily injurious, as being liable to provoke inflammation. When the abdominal section is completed, the operator should take a rapid glance at the position of the uterus. The organ will probably lie over to one or the other side, and the extent of this deviation from the straight line, should be ascertained by passing the hand into the abdomen as far as the side of the organ. If its obliquity be great, the uterus should be raised a little and supported by the assistant, because it is of great moment that the incision into it be made in as straight a direction through the anterior wall as possible. If the uterus lie very obliquely, an upper angle may present at the outer wound, and the consequence may be that the fallopian tube will be involved, and liable to division. With respect to the question of hæmorrhage, and to the necessary contraction of the organ on the removal of its contents, the longitudinal incision is most eligible.

**Uterus pressed towards mesial line.**

The section of the uterus may be made almost immediately; for the quantity of blood that flows from the outer wall is always slight, if the incision have been correctly made in the linea alba. The section of the exposed organ should be effected by a long superficial incision, gradually deepened and completed by a deep-grooved director, armed with a large but pointed knob; the length of the incision varying from five to seven, or even nine, inches, but dependent on the size of the organ. When the contents are fully exposed, the membranes should be ruptured by the hand, some part of the child will immediately present itself at the wound, the hand then grasping the entire fœtus, removes it to a length sufficient to tie the cord. The bleeding at this moment is considerable enough and often immense, and the patient sinks rapidly towards a state of deliquium. The hand is now again introduced into the uterus, for the purpose of removing the placenta, which is to be quickly, but gently, detached. If this structure occupy the anterior wall of the uterus, there remains no alternative but cutting through and detaching it as rapidly as possible, and even should this relation be ascertained before the operation is commenced, it would not justify any variety in the incision through the walls of the uterus. On removing the child, the uterus sinks, and the abdominal parietes hold a new relation to the contents. Tension is changed to flaccidity, blood flows copiously from the uterine walls, the atony of the muscles offers a very inefficient resistance to the escape of intestine, the prevention of which demands the greatest care, otherwise its descent is inevitable. Two pairs of hands, at least, are requisite for this purpose, and the best management will be required. The uterus rapidly contracts, and the hæmorrhage is reduced in amount during every subsequent minute. As the contraction approaches the natural dimensions of the organ the tendency of the intestine to escape is also diminished, and some ten to twenty minutes may be allowed to elapse for the entire cessation of the bleeding, and the restoration of the uterus to its natural size after delivery. I found great benefit to be derived from a circular bandage of about nine or ten inches in breadth, divided across the middle, and the cut edges connected by about a dozen strong silk threads, of eight or ten inches in length. This bandage is passed around the body of the patient before the operation is commenced, and on the contraction of

Section of uterus.

Division of placenta.

Circular bandage.

the uterus and the cessation of the hæmorrhage, it is to be drawn down over the abdomen, and held lightly by two assistants. It will be found to form an excellent temporary substitute for closure of the abdominal wound, while it permits free manipulation, between the threads, in the passing of sutures. The operator should give ample time for the uterus to contract. If blood continues to flow, it is much better that the escape be visible than that it flow into the abdomen, after the wound is closed.

Patient arrest of hæmorrhage.

Intestine in uterine wound.

The other considerations yet require notice: first, the indispensability of ascertaining that no portion of intestine is involved in the uterine wound, which has occasionally caused fatal strangulation; and, secondly, the patency of the os uteri should be ascertained by the introduction of the finger into the cervix. The wound may now be united by sutures passed through the substance of the abdominal parietes, but not including the rectus muscle, if exposed. Perhaps ten or twelve may be employed. The last inch above the pubes may be left ununited, in order to permit the escape of blood, or lochial discharge. Strips of sticking-plaster should be applied over the sutures, and a moderate compress of cotton-wool will complete the operation.

Complete preparation.

The Cæsarean operation should be rapidly and boldly executed. Every appliance that contingencies may require should be readily at hand, including a warm-bath for the child, and other material of the nursery. Neither the linea alba nor the uterus is highly sensitive, and may be divided freely. In my first operation, the child was in the arms of the nurse in five minutes and a half from the time of the first incision. In the second, in six minutes and a half; but safety requires that the subsequent stages of the operation be executed with care and deliberation.

After-treatment.

The after-treatment of the Cæsarean operation consists in allaying suffering, in upholding the vital powers, and in fostering the recurrence of the natural functions of the body. The first indication is upheld by ease of position, and by the agency of such sedative medicines as will tend to "steep the senses in forgetfulness," without impairing the internal functions of the body. I plead guilty to the error of excessive pressure on the abdomen in my first case, and I was so far myself unmindful of one important indication. The patient survived about thirty-six hours. In the second case, in conjunction with my friend Dr. West and other eminent physicians, my patient was treated with opium in rather large doses, both by the stomach and by enema; and so far successfully. The young woman was constitutionally irritable, with a standard pulse of one hundred and twenty, and had been previously insane. The patient survived to the sixth day, and then sank. Both infants survived.

The loss of blood incidental to the division of so large vessels compels the early resort to food as the best protective against inflammation. The secretory functions of the body generally, especially those of the skin and kidneys, should be encouraged, but the intestines should be kept in a state of perfect quietude for several days. An occasional injection is all that is required. Local pains should be treated with opium, and not by depletion.

## ON OVARIOTOMY.

This large and serious operation is resorted to, for the purpose of effecting a permanent cure in cases of ovarian dropsy. The proposition of the removal, by section of the abdominal parietes of the secreting cyst of an ovary, is not a recent one; but the execution has, within the last ten years, been attended with results that set at rest the early anticipations of danger, which emanated from many of the most experienced members of our profession. Abundant evidence is obtainable, justifying the resort to it as the radical means of removing a disease, the records of which have ever testified to its fatality, provided the cases be selected with skill and experience. Unhappily, the operation of ovariotomy is not applicable in all cases of ovarian cysts, nor, perhaps, in the majority of examples, unless we are permitted to enlarge the circle by the admission of cases in which the danger increases, and in which ultimate recovery is more than questionable.

**Nature and origin of the disease.**

With respect to the nature and origin of the disease, it is well known that the ovaries of the human subject are liable to the formation of cystic cavities, either singly or in numbers, occasionally clustered together like a bunch of grapes. Sometimes cysts form within cysts, and each presenting different characters, both as regards the material of the cyst and the nature of the contents. Some may be lined with a vascular membrane, and the exterior is often sub-cartilaginous in texture. One or several of such cysts may enlarge at any period of life after puberty, till they reach an enormous magnitude, distending the cavity of the abdomen, restricting the powers of respiration, by compression on the diaphragm, and impairing the function of digestion. The texture of cysts thus formed, varies materially in thickness, exhibiting sometimes the tenuity of a thin membrane, and occasionally acquiring the thickness and substance of a fleshy texture. As great a variety pervades the contents which, though generally serous and limpid, assume the varieties of albumen, lymph, puriform and purulent fluid; indeed, when the cysts are bilocular or multilocular, the contents of one or more of these tumours may vary in character from the rest. The resort to some agency more efficient than the temporary benefit derived from the ordinary operation of puncture, has been rendered necessary by the almost universal fatality that attends the disease, when subjected to the ordinary treatment of tapping. Of such cases it is rare that the patient survives the disease for a longer period than two years, and the majority die within twelve months. When, therefore, we consider the frequency and the fatal character of ovarian dropsy, it is not surprising that patients are found who will willingly submit to, and surgeons who will undertake an operation which, though not unattended with danger to life, yet offers the only alternative to almost certain death, by the substitution of means that will, if successful, terminate in their entire recovery. A most correct diagnosis of every case is indispensable to success, without which all is uncertain and unsafe. Indeed, we cannot form any approach to correct statistics of the operation, without the most accurate diagnosis; and the only mode by which we can legitimately reduce the extent of danger to its most moderate limits, is to resort to the radical cure only in such examples of the disease as offer a prospect of the greatest success, and to restrict the operation to cases composed of cysts, containing serum, or slightly albu-

Variety in the growth.

Frequent fatality.

Correct diagnosis.

minous. Unless the diagnosis be most accurately made, we are in ignorance both of the number and the nature of the cysts which, on exposure, may prove to be so large and so solid as to be unmanageable by the operator, by resisting evacuation by the largest canula passed into them. If diagnosis cannot decide on these matters, both as regards number and quality, the operation should demand yet further deliberation. If these conditions can be ascertained, and prove favourable to the experiment, there is no medical reason why the operation should not be undertaken.

History of the case.

The history of the case, founded on the report of the past symptoms, has no concern with the number of the cysts; that fact can only be ascertained by careful, and often by elaborate, manipulation; but with respect to the character of the contents, a question of perhaps equal importance, history is intimately concerned. In the watery cyst, the past symptoms are almost exclusively confined to such as are consequent on mechanical distension, and without pain or other concomitant, and may be of comparatively rapid growth; whereas, the solid contents indicate a more chronic progress, each form, however, being unaccompanied by local pain, except from the above cause. The puriform, and still more the purulent, contents are the consequence of local action, which has long been the accompaniment of pain and general derangement of health. Such are the occasional conditions consequent on the puncture by the trocar; inflammation follows the operation, and the new secretion becomes purulent instead of serous. Besides, the question of the nature and contents of the cysts is another, of no less moment, perhaps of yet greater importance, as regards the eligibility of the operation, than either of the above, viz., the adherent or non-adherent relation of the cyst to the structures around; for it is obvious, that however suitable may be the proposed operation, so far as relates to the structure of the sac and the nature of the contents, if the mass be adherent to any considerable extent, an operation is inadmissible. The cases selected, therefore, in which it may be most favourably resorted to, are such as have not been tampered with by frequent evacuation, or by the attempted cure by pressure, and have been free from all signs of in-

Purulent secretion dependent on local action.

Inflammatory cases contra-indicate the operation.

flammatory action, in which, as above described, the disease has travelled onwards without pain or serious illness, or the presence of any other sign beyond that of mechanical pressure, and the numerous lesser ailments arising from it. The case is, therefore, rendered less eligible, in which tapping has been even once resorted to; because it argues the greater probability of adhesions, and the liability to altered secretion; and unless the negative of these conditions be ascertained on examination, the operation becomes doubtful.

Impulse conveyed by slight concussion in fluid contents.

The knowledge to be acquired by examination demands both tact and delicacy. The first question to be determined relates to the simple or multilocular character of the mass, inseparably connected with which, however, is the nature of the contents. We must ascertain to what extent the impulse caused by tapping with the finger is felt over the abdomen. We should take any given point, and proceeding thence in all directions, obtain this information; for the impulse being conveyed with much greater facility through the medium of the fluid contents than of cyst itself, if obtained by a light and delicate manipulation, may be detected with great precision. The same action should then be repeated in the line of every transverse diameter; and supposing the impulse across to be perfect in all directions, we may deduce the fact of the absence of any large secondary cysts. In cases of large bilocular cysts, placed side by side and occupying the general cavity of the abdomen, the impulse conveyed, by concussion from right to left, is different from that from left to right; this difference depending on the concussion of a large mass of fluid passing through a small one, and *vice versâ*. This inquiry will be made with facility proportioned to the fluidity of the contents, as I have remarked in the earlier part of this work. According to the fluidity, and to the purely serous nature of the contents, will exist this facility of transmitting the impulse from side to side; and, indeed, it is worthy of remark how slight a concussion by the finger is conveyed across the tumour when an aqueous fluid is contained in a single cyst. These are niceties that may be acquired by practice, but which are perfected only in men of refined sensations. These two questions being determined, the third, which relates to

Questions of adhesions.

adhesion, can only be approached within the circle of probability. We test it by its general mobility; and, negatively, by the absence of local pain or former disease throughout the growth; and the probability of the absence of adhesion is further strengthened by the unilocular character of the cyst, which fact has already been ascertained. If the two former conditions have been established—if the impulse be conveyed across, responding to the slightest concussion of the finger, and not arrested in its course, requiring a new starting point to reach the opposite side, and there remain no evidence of adhesion obtained from mechanical examination and former history, and the patient's health be otherwise good, the case presents no indications precluding the resort to the operation.

Operation.

The patient is placed in a semi-reclining position in bed, leaning against a firm support, covered with pillows. The temperature of the room having engaged the attention of the profession, I would add one word on this subject. It is the practice of Dr. Frederick Bird, who performs this operation with great skill and dexterity, as I can myself bear witness, and has obtained the concurrence of others, to raise the temperature to a degree beyond that which is, in my opinion, very supportable either to the patient or the attendants; which temperature is retained so long as inflammation is impending. I quite concur with Dr. Bird, in the principle of averting inflammation by diaphoresis, and in the chapter on Aneurism I have given an example of my adhesion to this doctrine as far back as the year 1842; but I strongly object to the admission of any depressing agency during an operation, which, in my opinion, can only increase an evil already great. Elevate the temperature, if you please, during the time at which the inflammation may be anticipated, but not during the operation, for inflammation cannot appear for many hours afterwards; and I conceive, that the resort to this depressing agent should not be made until the shock of the operation has entirely passed.

Temperature of room.

The incision which is to be made with a strong scalpel, should occupy the mesial line of the linea alba. Its extent should be as short as possible. From four to five inches will suffice for the removal of any cyst for which an operation is admissible. Less than this length will increase the difficulty of manipulation, supposing the disease to prove multilocular and the contents very albuminous or fibrinous in character. With respect to the question of chloroform, I both adopt and recommend the resort to it; except, indeed, the opinion of the operator be pledged to the elevated temperature of the room, when it is, I conceive, contra-indicated by the tendency to faint.

The incision need not be carried above the umbilicus, nor quite down to the os pubis. The division should be made with some care through the fat and peritoneum, till the anterior surface of the sac is exposed. This membrane should then be seized with a strong pair of hooked forceps, with pointed and projecting teeth; by means of which the sac should be firmly held. As the fluid flows off, both the cyst and the prominent abdomen become reduced in size, and the former, gradually elongating, is drawn without effort through the wound. A second cyst may be brought into view, seized and punctured as before, and the entire cavity or cavities evacuated. By this process the cysts will collapse with the loss of their contents, and, unless adherent, will escape from the wound up to their root. If adhesions present and are susceptible of separation, the practice is obvious; if not, the contents of the cavity should be evacuated, and the cyst cut at a slight distance from the adhesion. Little or no blood will have escaped, and, generally speaking, the intestines remain passive, and are often not even visible during the operation. The neck or root of the cyst is to be surrounded by a strong and well waxed cord of silk, which is drawn tight around it, and the end, with that of the divided cyst, left hanging though the wound. All that now remains is, to apply several sutures to the wound, the edges of which should be brought into perfect apposition, to invest the abdomen with a layer of fine cotton wool, and to apply moderately firm pressure by means of a flannel roller. The patient, when replaced in bed, should be laid on her back, with the legs raised over a pillow sufficiently high to relax the abdominal muscles. For the after treatment I must refer the reader to the subject of the Cæsarean operation, and elsewhere, warning him against unnecessary depletion, by the agency of the

Treatment of adhesions.

lancet. The treatment of Dr. Bird is, I think, to be followed in principle, if not entirely in detail. The advantage of the administration of ice, in conjunction with diaphoresis, is very positive.

More recently the radical cure of ovarian cysts has been attempted by the injection of a solution of iodine. The evidence at present in its favour is not very satisfactory.

## ON THE ADMISSION OF AIR INTO VEINS.

A few words on this interesting subject.—Many examples of this terrible accident have been recorded, and I know of no circumstance which might occur during an operation more calculated to create alarm in the minds of all persons present. The great and sudden change, from life to apparent death, in many instances the obscurity of the cause, and therefore the doubt which must necessarily arise as to the efficacy of the means we should employ to restore the vitality of the patient, all conspire to confuse and embarrass the mind of the operator.

Regions most liable.

This accident has generally occurred during operations about the base of the neck or thorax, at some spot near the termination of the large veins in the heart; a fact not difficult of explanation when we bear in mind the influence exerted by inspiration upon the return of venous blood to the heart. The circumstances attending the entrance of air into a vein, are generally the following: The surgeon may be engaged in dissecting out some form of tumour from the base of the neck or axilla, and during the operation he renders tense the parts to be divided, in order to facilitate the action of the knife. At the moment of division, the patient inspires, perhaps deeply, by no means an uncommon occurrence during an operation, a hissing or gurgling sound is for a moment heard, or perhaps no sound may be audible, and the patient suddenly falls into a state of collapse, the powers of the circulation rapidly fail, the pulse ceases to be distinguishable, the respiratory movements are incomplete and irregular, a deadly pallor overspreads the countenance, the corneæ appear more or less hazy, and the irides become indifferent to the influence of light, the temperature rapidly falls, and a cold sweat partially bedews the

Attendant sound.

surface; in short, all the symptoms of approaching dissolution by syncope are present, and in a few minutes the patient ceases to live. In some instances the symptoms are rather allied to those of apnœa, combined occasionally with those of coma; the pulse, although still to be felt, being slow and irregular, with ineffectual and spasmodic attempts at respiration, and the countenance becomes livid. Should the patient be happily rescued from death, more or less severe symptoms of febrile excitement gradually supervene.

Post-mortem appearances.

The post-mortem appearances which have been generally observed, are briefly, great venous congestion; the right side of the heart more or less distended with blood, rendered frothy by the presence of air, of which a quantity is also usually found in the pulmonary artery, and more rarely in the vena cava superior; the left side of the heart contracted, containing little blood, and very rarely any air; the lungs appear healthy. I shall not venture to enter at length into any discussion concerning the proximate cause of death. Blood, rendered frothy by the presence of air, is incapable of passing through the minute capillaries of the lungs, and the evidence before us points to this fact as the chief one concerned in the production of death. How far the presence of air in the cavities of the heart may be primarily concerned in the annihilation of its movements, is not yet determined; but I am rather inclined to regard its impaired action as produced secondarily, by the disorder of the pulmonary circulation. The question has been discussed at considerable length, and numerous experiments performed, with a view to elucidate the phenomena observed. The subject has been especially investigated by Bichat, Rysten, Amussat, Sir C. Bell, Cormack, Dr. J. Reid, and more recently, by Mr. Erichsen.

Cause of death.

In all operations where this accident is liable to occur, we should employ every care to guard against its occurrence. We should hesitate to divide parts in a state of tension, where there is any probability of wounding a large vein, and more especially at the instant of inspiration, and it would be well, whenever a doubt may arise, to exert pressure between the parts to be divided and the heart. Should this accident unfortunately occur, our remedies to be effectual, must be promptly applied, there is no time to consult or consider, and barely sufficient to act. The first indication, of course, is to check the further entrance of air by pressure over the orifice. Should the symptoms be those of syncope, the patient, if not already reclined, should be placed horizontally, with the head lowered, and the application of warmth, friction, and stimulants made. Above all, artificial respiration should be most perseveringly employed. If the symptoms of asphixia predominate, the abstraction of a small quantity of blood from the external jugular vein, may in some cases be beneficial. Indications of treatment.

# CHAPTER XXX.

## AFTER TREATMENT OF OPERATIONS.

Rational and empirical.

The treatment consequent on large and critical operations, marks the surgeon, whether a correct observer of the phenomena of life, exhibiting a willing obedience to the laws by which the functions of the human organism are governed; or whether the unthinking adherent of traditional practice based upon the unsound physiology of a nearly bygone era. The former is guided by observation, the latter by rule. Of the first it may be said, his knowledge is progressive; of the second, his knowledge is completed, the cup is filled to the brim. Treatment by the one is rational; by the other, empirical.

Effects of an operation.

If we reflect on the two conditions of a person, the one prior, the other subsequent to a large operation, whether that of amputation, or the removal of the entire of a large breast, which has entailed a considerable loss of blood, we are naturally led to enquire in what respect they differ. At a period shortly previous to the operation his arterial system was engaged in the circulation of the exact quantity of blood required for health, and his nervous system was in perfect harmony with it. From his arterial system, one or more pints of blood have escaped, the quantity remaining in his blood vessels being diminished to that extent. In the same degree has his nervous system lost its tone; he is agitated by every exciting cause. His mental system has sustained a shock, and is prostrate in a ratio with the excess of his former anxiety, his fear, his hope, or whatever may have been the predominant emotion of his mind. The pabulum of animal life is diminished below the standard of health by a sudden loss occurring without the stimulus and support of necessity; his nervous system is shaken by the reduced supply of blood to his brain; his mind also has received a shock through the suddenness and severity of its emotions.

What then is this man's condition? Surely that of exhaustion of his vital powers, and the indications from which are obviously twofold. 1st. To replace the blood, and thus to restore the force and energy of his nervous system; and 2nd. To restore to both body and mind that tranquillity which the violence of the operation has deprived them of. Such are apparently the distinct indications to be obeyed by the judicious surgeon. Let it be recollected that reparatory actions are now called into requisition,—actions requiring additional force for their perfect accomplishment,—and actions demand powers, those powers already weakened by loss of blood. We are in truth claiming an extra work on a reduced diet scale. These are actions not merely of supply, but of repair.

Indications of treatment.

It is clearly the first duty of the surgeon to endeavour to grant this support—to replace the patient as nearly as possible in the condition from which the occurrences of the last two hours have removed him—by tranquillising his nervous system, and by the addition of new blood. If we fail in this indication, whether through ignorance or through neglect; if we hold to the antiquated, and happily nearly obsolete doctrines of the "secretions," and administer a purgative or an "alterative;" and even if we indulge in groundless apprehensions of inflammation; if we fail to observe the enormous capacity for stimulants that a man so conditioned now manifests, or to note the benefit arising from their administration, we are not competent to cope with the frightful and often fatal shock to the economy from large operations, attended by loss of blood—and death will follow. And death does follow an occasional operation possibly of no magnitude, and from which the loss of blood has not been great, in the direct relation of cause and effect; and a brief period of eight and forty hours may close the scene. We have here no inflammation or inflammatory tendencies, no hæmorrhage, no gangrene, no effusion; the man becomes restless, his pulse rises in frequency, febrile irritation indicated by a hot skin, a rapid pulse, eccentricity of thought and expression, delirium, and death. Such cases are not infrequent, and when once in the ascendant they mock all remedies as worthless. It may be asked by an unobserving surgeon, whence the cause of a result so unexpected? The answer is, a fatal shock to the man's nervous system. Unexpected it may prove, but the ratio of surprise will be inversely proportioned to the close and vigilant observation of this man's condition prior to the operation. We may now recollect that he had eaten little food for many days or weeks, or that he had not recovered from an attack of sickness or diarrhœa, or that his fear of death had greatly preponderated over his hope of recovery. This fatal anticipation will occasionally take possession of the mind, especially in the case of women. I operated on a lady of remarkable force of character and of unusual mental vigour, her courage and self-possession were singularly prominent in her entire conduct up to the moment of the operation, and yet those around her observed a failure in her resolution on the day fixed for its performance. I urged postponement, which she strenuously resisted. She had laid herself on the table, and chloroform was about to be administered, when she suddenly sprung up and exclaimed, "I am certain I shall die!" I removed the disease. The loss of blood did not exceed a few ounces, but within fifteen hours she was dead. It was not till after her death that I learnt she had not eaten a substantial meal for several weeks, but had supplied the place of food by the resort to an excessive quantity of wine, which fact had been studiously concealed from me. Her condition was unnatural. Her nervous system was suddenly unstrung, and her vital powers sank.

Influence of mind.

Exhaustion.

In other examples death is more remote. In them the vital powers are undermined by gradual exhaustion, which such stimuli as are usually administered fail to arrest. They also argue a morbid state of debility at the time of the operation from which the person never rallies. From the first, the issue is doubtful—till the stage of suppuration turns the scale against them. The healing process is arrested, days pass without progress, an erythematous blush encircles the wound, appetite fails, sleep is broken, the erythema increases, and a red blush of so-called erysipelas extends around. Exhaustion becomes extreme, the pulse increases in rapidity, the stomach rejects food, and death follows.

Phlebitis.

Another occasional consequence attendant on surgical operations is that of phlebitis or inflammation of veins, Local.

General.

passing on into pyemia, and too often, when established, terminating in death. When the disease is local it exhibits itself in the form of a firm thickening of the veins in the neighbourhood of a wound, whether made by art or by accident. The veins are hard and distended and roll under the finger; often they are painful on pressure, but not invariably so. The cellular structure around is more or less involved. This local state of the vessels may constitute the entire disease, by the vein being blocked by coagula, to their or its junction with the first branch above; or the disease may progress into the suppurative stage, during which the purulent contents of the veins will be carried onwards into the general venous circulation, forming local abscesses in the tissue, whether of the lungs, or the liver, or the areolar structure of any other locality of the trunk or extremities. This division of the disease (phlebitis), is that adopted by Dr. Watson in the last edition of his work, who describes the three forms as consisting of the adhesive, the circumscribed suppurative, and the diffused suppurative. In an admirable paper in the Med.-Chir. Transactions, Mr. Arnott first directed the attention of the profession prominently to the subject of phlebitis. In this paper, that eminent surgeon most accurately describes the condition of the veins, and the changes they undergo, noting the extension of the inflamed membranes upwards, often terminating abruptly at the junction of the affected vessel, with the trunk above it.

Neither phlebitis, nor pyemia, are however, frequent results of surgical operations, so far as I have seen; and I believe they are more commonly found in the medical than in the surgical wards of a hospital. Dr. Watson remarks, that "Suppurative phlebitis is liable to arise, not only after severe, but also after slight injuries, from the trivial as well as the grand exploits of surgery, viz., spontaneously as it were, without any local hurt, under the agency of natural causes, such as exposure to cold." Phlebitis, is in truth, a rare result of local violence. It is a disease essentially asthenic in its nature, and depletion, beyond the occasional application of a few leeches, I believe to be quite inadmissible. Greater is my confidence in the local employment of *hot* fomentations followed by the inunction of mercurial ointment with opium, and rolling with flannel. In more advanced cases of phlebitis, ending in local abscesses, whether in the areolar tissue, or in joints, which constitutes pyemia, the asthenic type of the disease is clearly marked by every sign of debility. For my own convictions, I need no better evidence than that derived from the fact of the entire absence of cases of pyemia from my wards in St. Bartholomew's, for the last three years; not one single case having presented itself for treatment during that long period, whether spontaneous or the result of violence.

Principles of after-treatment.

Such is the general course, and such the cause of the occasionally fatal result of operative proceedings. Again, then, let me urge on the young surgeon to keep in view the two prominent requirements of his patient — the supply of new blood, and perfect rest to the nervous system. Which of these is the more immediately indicated will depend on the circumstances of the individual case, and the present condition of the patient. If the loss of blood have not been considerable, quietude may be obtained by sedatives, administered as soon as the patient is placed in bed, and the chamber restored to its ordinary condition by the removal of all the appliances of the operation. Sleep should be encouraged, and every possible cause of personal or mental discomfort removed. This may be effected by a moderate dose of morphia. A quarter to a third of a grain will suffice for the purpose. The constipating property of the opiate can scarcely be deemed an objection to its use, because any degree of activity of the intestinal system should be carefully avoided. Two or even three days may often be allowed to elapse before the bowels are disturbed by aperient medicine. This of course infers a sufficient action on the morning of the operation. With a view to restore the force of the circulation, stimulants may be administered not only freely but largely, and combined with any form of nutrient that is palatable, such as strong decoction of meat, with the addition of farinaceous food, such as biscuit powder, arrowroot, sago, or maccaroni, eggs with brandy or sherry, and isinglass. The capacity of the individual so circumstanced for stimulants, is very great. I am persuaded it is far greater than is generally believed. If we recollect the enormous quantity of

Stimulants.

brandy that may be consumed by persons when reduced by the sudden loss of blood to the verge of death, or by those equally depressed by intense cold, or during the prostrate condition of the heart in sudden collapse of the nervous system—when glass after glass of pure brandy is poured down the throat of the almost unconscious patient, without producing the smallest appearance of reaction—we have assurance of safety in the free administration of stimulants in the present depressed condition of our patient. In stimulants will be found the only safeguard against such collapse as frequently follows large operations, and to which there exists a tendency in a greater or less degree in all. In stimulants will, in my opinion, be found the only protection against local congestion, erysipelas, or pyemia—which are but manifestations in different degrees of loss of vital power. In an aggregate of 150, I have, within the time specified, performed about eighty large operations in surgery, without one example of phlebitis or pyemia. No moderate quantity of any undiluted spirituous drink will produce evidence of excitement, and still less of intoxication, from which may be inferred *a capacity* for the stimulants, and if a capacity, assuredly *a want*. For some years past, I have noted the efficacy of stimulants given under the conditions above described. In the year 1855, a succession of operations in St. Bartholomew's Hospital for cancer of the breast were succeeded by prostration, and erythema of the skin around the wound, sometimes extensive. I need hardly say, that such condition of the integuments indicates a total suspension of the healing process. The next case that presented itself, I treated with stimulants. I gave her an ounce of brandy, a little diluted, every four hours, and continued it at intervals of increasing length for the next forty-eight hours; she had neither prostration, consecutive fever, nor erythema around the wound, and her recovery was rapid. I conceive the principle to be sound. Its success is especially marked in cases where the loss of blood has been considerable, or in which the nervous system gives evidence of unsteadiness. The treatment is even more distinctly indicated where the subject of the operation has been largely addicted to spirituous or fermented drinks.

It is much the practice of a former school of surgery to administer salines and diaphoretics, such as antimony, acetate of ammonia, nitrous æther, and there can be no objection to their employment, provided, if without especial indication to the contrary, they act neither on the skin, on the kidneys, nor on the bowels. If given to avert the sensation of thirst, we should recollect that no indication of debility is more manifest than this. The fever itself exhibits the low type of genuine weakness, and such remedies as draw upon the circulation in reality aggravate the evil they are intended to remove. More rational and far more efficiently is the sensation combated by weak dilutions of wine and water, brandy with lemonade rendered effervescent by alkali, &c. When the suppurative stage is established, bark and ammonia of all drugs will best contend against the tendency to consecutive fever.

Treatment of wound.

The wound should be frequently examined, so far as that is possible, between the plasters and around, for six or eight hours after the operation, for the purpose of ascertaining whether any or what quantity of blood has escaped; we may find every quantity between oozing and hæmorrhage. This will be determined by the extent to which the dressings are saturated. If discoloured in one direction only, and to the distance of about an inch or two from the wound, if the stains of blood are stationary and not increasing, although the discoloration be considerable, there may be ground for fear lest early union by direct adhesion be arrested by coagula, but not sufficient to warrant the exposure of the wound; but if the bleeding be large and the dressings more generally saturated, it is better at once to remove them to expose the cavity, and arrest the hæmorrhage. Secondary hæmorrhage, if it occur at all, may be dated from the hour of the operation. Its extent may be calculated, and its requisite treatment adopted within the limit at which we endanger the process of union by the first intention, or direct adhesion; therefore no permanent injury is sustained to the wound by reopening it, however injurious it may prove to the individual. It does not of course follow that even the ascertained presence of coagula justifies the removal of the plaster, and the exposure of the interior of the wound. We have to fight against early prostration, and consecutive fever, by the side of which, a wound healing partially, or even entirely by granulations, is a matter of little moment.

The date of the first dressing of a large and deep wound, whether a stump or an excavation, will be determined by its condition. If the surface around be cool and pale, and the dressings continue dry, the second day may be passed without interference. These periods vary in the different seasons of the year. In cold weather, and in favourable conditions of health, the period may be extended to the third day, *i. e.*, from Monday to the Thursday following, whereas in the heat of summer, the previous day will indicate the necessity of renewing the dressings. Such is the debilitating influence of heat. The plaster will be found to be moistened with a sanious discharge, yielding a fœtid odour, and further discoloured by the action of the sulphuretted hydrogen on the lead. A red tinge borders the wound. The union of the opposite sides is very slight, and readily separable. Whereas in wounds that sanction the postponement to the third or sometimes to the fourth day, we find the plasters dry, the integuments both pale and cool to the touch, and the union of the opposite sides of the wound by direct adhesion almost complete.

In perfectly healthy wounds, the dressings may be renewed every alternate day; in all others, their renewal is required daily. (For more detailed remarks on the after-dressing of wounds, *see* Chapter III.)

# APPENDIX.

◆

The accompanying woodcut represents an instrument which is used by Mr. Webber for the suppression of arterial hæmorrhage. The bleeding extremity of the artery is seized and forcibly compressed, the teeth at the same time lacerating the coats (fig. 1). The principle upon which it acts is very readily understood. The cleanly-cut end of the vessel is reduced to a condition somewhat similar to that of an artery which has been torn across. Mr. Webber speaks very positively of its success, even for such arteries as the brachial and femoral.

*Butcher's Saw*, as it is generally called, is a very convenient instrument in certain cases of resection. The blade, which may be separated and readily replaced, is very thin and delicate, and the cutting edge may be turned in any direction (fig. 2).

I believe there is more than one claimant for the honour of the invention.

I have found a sound of this shape, having a much smaller curve than the ordinary one, and the extremity somewhat enlarged (fig. 3), a very convenient and efficient instrument for the detection of a stone in the bladder. It is readily introduced, and can be moved in the bladder with much greater facility than the common sound,

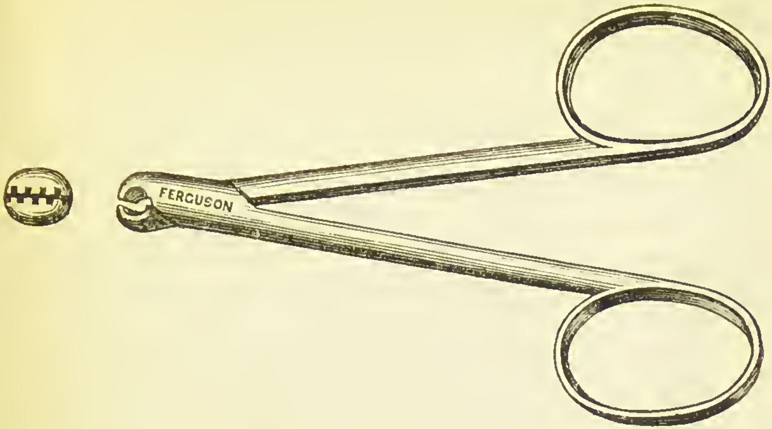


Fig. 1.

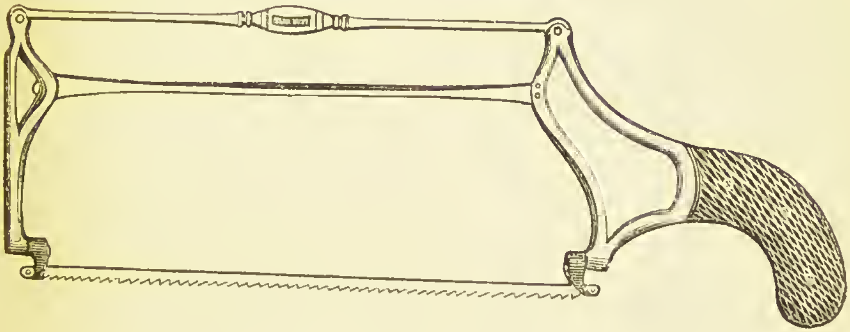


Fig. 2.

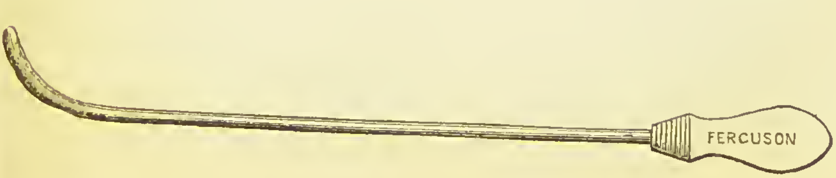


Fig. 3.

so that every portion of the interior can be most satisfactorily explored.

This small lithotrite is a very convenient instrument in some cases. The crushing force is obtained by the simplest mechanism, and its short curve gives it all the advantages of the preceding instrument (fig. 4). It is especially applicable to the case of young subjects, or where the stone is small, or has been already much broken. As the sketch shows, the force is obtained by the pressure of a single screw.

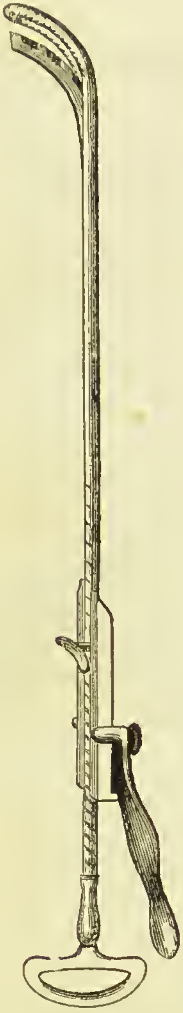


Fig. 4.

# INDEX

TO

## INSTRUMENTS AND APPARATUS REQUIRED FOR SPECIAL OPERATIONS.

---

### WOUNDS IN GENERAL.

Pocket Case, containing scalpel, director, probe, forceps, scissors, tenaculum, Assalini's forceps.

Lint. — Ligature silk of two sizes. — Needles. — Adhesive plaster. — Sponge. —Cotton Wool. —Bandage.

### DISLOCATIONS.

#### DISLOCATIONS IN GENERAL.

Ample quantity of strong cord, wash-leather, or linen washed with caoutchouc, to encircle the limb. —Pullies. —Two staples. —Two or more rollers. —Cotton wool. —Lint. —Chloroform.

#### DISLOCATION OF HUMERUS.

Failing the heel in the axilla, the metal knob, previously described.

#### DISLOCATION OF FEMUR.

Round towel, or leather loop for counter-extension.

### FRACTURES.

Ample quantity of tow, horse-hair, or cotton wool for pads. —Pads, large and thick, especially at the edges. —Linen for bandage. —Splints, two, three, or four, of wood or metal. —Straps, or linen rollers. —Leg-box, or cradle for lower extremity. — Scissors. — Chloroform.

#### COMPOUND FRACTURE.

Interrupted splint. — Scalpels. —Forceps. —Small saw. —Bone forceps. —Needles. —Silk. — Sponge. — Adhesive plaster. —Oiled silk. —Pocket case. —Chloroform.

### ANEURISM.

Case of scalpels. —Retractors. —Director. —Probe. —Two pairs of forceps, fine and blunt-pointed. —Assalini's forceps. —Ligature silk, thick and waxed for large vessels, and fine for lesser. —Two or three varieties of ligature needles. — Tourniquet. — Scissors. — Half-a-dozen silk threads for tying wounded arteries, each from ten to twelve inches in length. — Two armed needles for sutures. — Two rollers. — Adhesive plaster. — Four sponges. — Lint. — Chloroform.

### NÆVI MATERNI.

Strong nitric acid. —Glass rod. —Potassa fusa, acetic acid. —Three armed needles for sutures. —Lint. —Sponge. (See description).

### VARICOSE VEINS.

#### CURE BY CAUSTIC.

Half-an-ounce of powdered potash and quicklime, in separate stoppered bottles. —Spirits of wine, in a third bottle. —A large piece of freshly-made adhesive plaster. —Lint. —Sponge. —Rollers.

## AMPUTATIONS.

### AMPUTATIONS IN GENERAL.

Amputating knives. — Catlin. — Saw. — Bone forceps.—Two pairs of forceps.—Assalini's forceps.—Tenaculum.—Tourniquet.—Director.— Razor.— Scissors. — Calico or linen for retractor. — Twelve ligatures, from ten to twelve inches in length.—Four armed needles. —Adhesive plaster.— Cotton wool. — Two rollers. — Oiled silk. — Four sponges.—Chloroform.

### FLAP OPERATION.

A long straight-pointed knife.—Eighteen ligatures.—Eight armed needles for sutures.

### HAND OR FOOT.

Two strongly-made scalpels.—Metacarpal saw.—Bone forceps.

### PHALANGES.

Fine scalpels.—Bone forceps.

## EXCISIONS.

Case of scalpels.—Forceps.—Bone forceps.—Saws of various kinds.—Gouges. — Ligatures. — Armed needles. — Sponges. — Lint. — Plaster. — Pocket case.—Splints.—Chloroform.

## NECROSIS, &c.

Scalpels.—Gouges. — Common and bone forceps. — Saws of various kinds. — Trephines. — Ligatures. — Probes. — Needles.—Sponges. — Lint. — Plaster. —Pocket case.—Chloroform.

## TUMOURS.

Grooved needle.—Case of scalpels.—Two pairs of forceps.—Assalini's forceps. —Four armed needles.—Four sponges. —Two rollers.—Lint.—Cotton wool. —Adhesive plaster.—Pocket case.—Chloroform.

### *In large Tumours of Extremities, &c.*

Tourniquet. — Grooved needle, or fine trocar.—Small saws, if osseous.—Two metallic retractors or elevators.—Six or eight armed needles.—Silk for ligatures.

In Mammary tumours, when large, compress the subclavian artery against the first rib.

## BURSÆ.

Long needle with silk.

## OPERATION FOR ELEVATING DEPRESSED CRANIAL BONE.

Case of scalpels. — Trephine. — Hey's saw; other small saws.—Elevator.—Forceps.—Ligature silk.—Two rollers. — Four sponges. — Lint. — Adhesive plaster.—Pocket case.

## RHINOPLASTIC OPERATION.

Case of scalpels.—Two pairs of forceps. —Four small needles, armed.—Twelve minute needles, also armed.—Two pieces of cork or sponge for aperture of nostrils.—Lint.— Four sponges.—Adhesive plaster. — Pocket case. — Chloroform.

## POLYPUS NASI.

Variety of polypus forceps.—Double canula, with fine wire and silkworm gut. —Sponge.

## HARE-LIP.

Two fine scalpels.—Two straight silver needles, with moveable steel points.—Strong silk thread, waxed. —Three small needles, armed. — Sponge. — Pocket case.—Chloroform.

## RANULA.

A curved needle, armed, with double silk, waxed.

## REMOVAL OF TONSILS.

Tonsil knife.—Vulsellum, with scissor handles, or guillotine.

## STAPHYLORAPHY.

Case of fine knives.—Six curved needles of half an inch in length, armed.—

Forceps; second pair, with one longer arm to hold the soft palate.— Two small and soft sponges, firmly fixed on pencils of wood, for cleansing the palate.—Instrument for reversing the needle.—Lint.—Pocket case.—Ice.

## TRACHEOTOMY.

Case of scalpels.—Two pairs of forceps. Dr. Hall's trocar.—Chain trocar.—Gum tube for trachea.—Spring dilator. —Tenaculum.—Four small sponges.—Ligature silk.—Adhesive plaster.—Pocket case.—Tube for trachea.

## PARACENTESIS THORACIS.

Grooved needle. — Case of scalpels. — Forceps.—Flat trocar, with canula.—Thompson's trocar.—Gum catheter.—Adhesive plaster. — Pocket case. — Elastic bandage for chest.

## PARACENTESIS ABDOMINIS.

A moderate-sized trocar.—Fine trocar. —Broad flannel bandage.—Adhesive plaster.—Pocket case.

## HERNIA.

Case of scalpels.—Two directors, of varying sizes.—Two pairs of fine forceps.—Tenaculum.—Cooper's hernia knife.—Probe-pointed bistoury. — Scissors. — Ligature silk.—Four armed needles.—Adhesive plaster.—Lint.—Ample quantity of cotton wool.—Two rollers.—Razor.— Pocket case.— Four sponges. —Chloroform.

(For the radical cure, see description.)

## PHYMOSIS.

Straight-pointed bistoury.— Directors. — Scissors.

## HYDROCELE.

Grooved needle.—Small trocar, with canula.—Metal syringe to fit.—Half an ounce of tincture of iodine, for radical cure.

## HÆMATOCELE.

Case of scalpels. — Metal syringe. — Sponge.—Pocket case.—Chloroform.

## CASTRATION.

Case of scalpels.—Forceps.—Strong silk for spermatic cord. — Fine silk for vessels.—Six armed needles.—Lint.—Pocket case.—Chloroform.

## CATHETERISM.

### RETENTION OF URINE.

Eight silver catheters, from No. 2 to No. 9, inclusive.—Six gum catheters, from No. 3 to No. 9.—Opium suppositories of two or three grains.—Oil.

### IN ENLARGED PROSTATE GLAND.

Three metallic and three gum catheters of about the middle size.—Large prostatic catheter.—One large and long catheter.

### EXTRAVASATION OF URINE.

Case of scalpels.—Two or three gum catheters, Nos. 5, 7, and 9.—Sponges. —Pocket-case.—Chloroform.

## STRICTURE, OR RUPTURED URETHRA.

Case of scalpels.—Three silver catheters. —Two or three gum catheters, Nos. 4, 6, and 8.—Director.—Forceps.—Ligature silk.—Pocket case.—Chloroform.

## PUNCTURE OF THE BLADDER.

Moderate-sized trocar with canula, long curved trocar.—Gum catheter, of size sufficient to pass through the canula. —Adhesive plaster.—Pocket case.—Chloroform.

## FISTULA IN PERINEO.

Three silver, and three gum catheters.—Director.—Razor.—Lint.—Strong silk for retaining catheter.—Pocket case.—Chloroform.

## HÆMORRHOIDS.

Double silver canula. — Flexible wire bistoury. — Scissors. — Pocket case.—Nitric Acid.—Chloroform.

## FISTULA IN ANO.

Sharp and probe-pointed bistoury—Director.—Piece of soft wood or rectum bougie, to receive the sharp point of the bistoury. —Eyed probe. —Strong silk.—Blunt-pointed forceps, to catch the thread in the rectum. — Pocket-case. —Chloroform.—Oil.

## LITHOTRITY.

Two sounds. — Two silver catheters. — Metal syringe, with stop-cock to fit.— Two lithotrites.—Two pairs of long forceps for the urethra.—Oil.—Clean warm water at ninety degrees.

## LITHOTOMY.

Sounds.—Grooved staves.—Garters, or straps.—Razor.—Lithotomy knives.— Straight blunt-pointed bistoury. — Three or four pairs of lithotomy forceps. —Scoops.—Large gum catheter.—Metallic syringe to fit.—Common forceps. — Assalini's forceps. — Tenaculum.— Sponges.—Oiled silk.—Pocket case.— Chloroform.—Oil.

## TALIPES.

Tendon knives. —Roller. — Lint. — Adhesive plaster.—Pocket case.
(For apparatus see description).

## GUN-SHOT WOUNDS.

Case of Scalpels.—Two pair of forceps.— Probe. —Director. —Bullet forceps.— Hey's saw. — Trephine. — Tourniquet. —Pocket case.—Amputating case ?— Linen.—Lint.—Four armed needles.— Ligature silk. — Adhesive plaster.— Sponges.—Chloroform.

## CÆSAREAN OPERATION.

Broad bandage, interrupted by silk threads, placed around the chest before operating.—Strong short-bladed scalpels.—Director, with a bulbous point. —Common director.—Pair of scissors, and thread for umbilical cord.—Twelve armed needles.—Four large sponges. — Oil. — Adhesive plaster. — Cotton wool. — Flannel roller. — Flannel, and warm bath, for child.—Pocket case.— Chloroform.—Oiled silk.

## OVARIOTOMY.

Strong scalpels. —Long-toothed forceps, with firm wooden handles. — Large-sized trocar, with canula.—Strong silk for tying cyst, or waxed twine.—Fine ligature silk.—Four armed needles.— Adhesive plaster. — Lint. — Flannel roller.—Cotton wool.—Pocket case.— Chloroform.

WELLCOME LIBRARY INSTITUTE

# A CATALOGUE

OF

# NEW WORKS IN GENERAL LITERATURE

PUBLISHED BY

LONGMAN, BROWN, GREEN, LONGMANS, AND ROBERTS

39 PATERNOSTER ROW, LONDON.

## CLASSIFIED INDEX

### Agriculture and Rural Affairs.

| | |
|---|---|
| Bayldon on Valuing Rents, &c. | 5 |
| Cecil's Stud Farm | 8 |
| Hoskyns's Talpa | 11 |
| Loudon's Agriculture | 14 |
| Low's Elements of Agriculture | 14 |
| Morton on Landed Estates | 17 |

### Arts, Manufactures, and Architecture.

| | |
|---|---|
| Bourne on the Screw Propeller | 6 |
| Brande's Dictionary of Science, &c. | 6 |
| " Organic Chemistry | 6 |
| Chevreul on Colour | 8 |
| Cresy's Civil Engineering | 8 |
| Fairbairn's Information for Engineers | 9 |
| Gwilt's Encyclopædia of Architecture | 10 |
| Harford's Plates from M. Angelo | 10 |
| Humphreys's *Parables* Illuminated | 12 |
| Jameson's Sacred and Legendary Art | 12, 13 |
| " Commonplace-Book | 13 |
| König's Pictorial Life of Luther | 10 |
| Loudon's Rural Architecture | 14 |
| Mac Dougall's Campaigns of Hannibal | 15 |
| " Theory of War | 15 |
| Moseley's Engineering | 17 |
| Piesse's Art of Perfumery | 18 |
| Richardson's Art of Horsemanship | 19 |
| Scoffern on Projectiles, &c. | 20 |
| Scrivenor on the Iron Trade | 20 |
| Steam Engine, by the Artisan Club | 6 |
| Ure's Dictionary of Arts, &c. | 23 |

### Biography.

| | |
|---|---|
| Arago's Lives of Scientific Men | 5 |
| Brialmont's Wellington | 6 |
| Bunsen's Hippolytus | 7 |
| Crosse's (Andrew) Memorials | 9 |
| Gleig's Essays | 10 |
| Green's Princesses of England | 10 |
| Harford's Life of Michael Angelo | 10 |
| Lardner's Cabinet Cyclopædia | 13 |
| Maunder's Biographical Treasury | 15 |
| Mountain's (Col.) Memoirs | 17 |
| Parry's (Admiral) Memoirs | 18 |
| Russell's Memoirs of Moore | 16 |
| " (Dr.) Life of Mezzofanti | 20 |
| SchimmelPenninck's (Mrs.) Life | 20 |
| Southey's Life of Wesley | 21 |
| " Life and Correspondence | 21 |
| Stephen's Ecclesiastical Biography | 22 |
| Strickland's Queens of England | 22 |
| Sydney Smith's Memoirs | 21 |
| Symonds's (Admiral) Memoirs | 22 |
| Taylor's Loyola | 22 |
| " Wesley | 22 |
| Uwins's Memoirs and Letters | 23 |
| Waterton's Autobiography and Essays | 34 |

### Books of General Utility.

| | |
|---|---|
| Acton's Bread-Book | 5 |
| " Cookery-Book | 5 |
| Black's Treatise on Brewing | 6 |
| Cabinet Gazetteer | 7 |
| " Lawyer | 7 |
| Cust's Invalid's Own Book | 9 |
| Gilbart's Logic for the Million | 10 |
| Hints on Etiquette | 11 |
| How to Nurse Sick Children | 12 |
| Hudson's Executor's Guide | 12 |
| " on Making Wills | 12 |
| Kesteven's Domestic Medicine | 13 |
| Lardner's Cabinet Cyclopædia | 13 |
| Loudon's Lady's Country Companion | 14 |
| Maunder's Treasury of Knowledge | 15 |
| " Biographical Treasury | 15 |
| " Geographical Treasury | 16 |
| " Scientific Treasury | 15 |
| " Treasury of History | 16 |
| " Natural History | 16 |
| Piesse's Art of Perfumery | 18 |
| Pocket and the Stud | 10 |
| Pycroft's English Reading | 19 |
| Reece's Medical Guide | 19 |
| Rich's Companion to Latin Dictionary | 19 |
| Richardson's Art of Horsemanship | 19 |
| Riddle's Latin Dictionaries | 19 |
| Roget's English Thesaurus | 20 |
| Rowton's Debater | 20 |
| Short Whist | 21 |
| Thomson's Interest Tables | 22 |
| Webster's Domestic Economy | 24 |
| West on Children's Diseases | 24 |
| Willich's Popular Tables | 24 |
| Wilmot's Blackstone | 24 |

## Botany and Gardening.

Hassall's British Freshwater Algæ . 11
Hooker's British Flora . . . . . 11
“ Guide to Kew Gardens . . 11
“ “ “ Kew Museum . . 11
Lindley's Introduction to Botany . . 14
“ Theory of Horticulture . . 14
Loudon's Hortus Britannicus . . 14
“ Amateur Gardener . . . 14
“ Trees and Shrubs . . . 14
“ Gardening . . . . . 14
“ Plants . . . . . . 14
Pereira's Materia Medica . . . 18
Rivers's Rose-Amateur's Guide . . 19
Wilson's British Mosses . . . . 24

## Chronology.

Blair's Chronological Tables . . . 6
Brewer's Historical Atlas . . . 6
Bunsen's Ancient Egypt . . . 7
Calendars of English State Papers . 7
Haydn's Beatson's Index . . . 11
Jaquemet's Chronology . . . . 13
“ Abridged Chronology . . 13

## Commerce and Mercantile Affairs.

Gilbart's Treatise on Banking . . 10
Lorimer's Young Master Mariner . . 14
Macleod's Banking . . . . . 15
M'Culloch's Commerce and Navigation 15
Murray on French Finance . . . 18
Scrivenor on the Iron Trade . . . 20
Thomson's Interest Tables . . . 22
Tooke's History of Prices . . . 22

## Criticism, History, and Memoirs.

Blair's Chron. and Historical Tables . 6
Brewer's Historical Atlas . . . 6
Bunsen's Ancient Egypt . . . 7
“ Hippolytus . . . . 7
Calendars of English State Papers . 7
Capgrave's Illustrious Henries . . 8
Chapman's Gustavus Adolphus . . 8
Chronicles and Memorials of England . 8
Connolly's Sappers and Miners . . 8
Conybeare and Howson's St. Paul . 8
Crowe's History of France . . . 9
Fischer's Francis Bacon . . . . 9
Gleig's Essays . . . . . . 10
Gurney's Historical Sketches . . 10
Hayward's Essays . . . . . 11
Herschel's Essays and Addresses . . 11
Jeffrey's (Lord) Contributions . . 13
Kemble's Anglo-Saxons . . . . 13
Lardner's Cabinet Cyclopædia . . 13
Macaulay's Critical and Hist. Essays . 14
“ History of England . . 14
“ Speeches . . . . 14
Mackintosh's Miscellaneous Works . 15
“ History of England . . 15
M'Culloch's Geographical Dictionary . 15
Maunder's Treasury of History . . 16
Merivale's History of Rome . . . 16
“ Roman Republic . . . 16
Milner's Church History . . . . 16
Moore's (Thomas) Memoirs, &c. . . 16
Mure's Greek Literature . . . 17
Normanby's Year of Revolution . . 18
Perry's Franks . . . . . . 18
Raikes's Journal . . . . . . 19
Riddle's Latin Dictionaries . . . 19
Rogers's Essays from Edinb. Review . 20
Roget's English Thesaurus . . . 20
Schmitz's History of Greece . . . 20
Southey's Doctor . . . . . 21
Stephen's Ecclesiastical Biography . 22
“ Lectures on French History . 22
Sydney Smith's Works . . . . 21
“ Lectures . . . 21
“ Memoirs . . . 21
Taylor's Loyola . . . . . . 22
“ Wesley . . . . . . 22
Thirlwall's History of Greece . . . 22
Thomas's Historical Notes . . . 27
Townsend's State Trials . . . 22
Turner's Anglo-Saxons . . . . 23
“ Middle Ages . . . . 23
“ Sacred History of the World . 23
Uwins's Memoirs and Letters . . 23
Vehse's Austrian Court . . . . 23
Wade's England's Greatness . . . 24
Young's Christ of History . . . 24

## Geography and Atlases.

Brewer's Historical Atlas . . . 6
Butler's Geography and Atlases . . 7
Cabinet Gazetteer . . . . . . 7
Johnston's General Gazetteer . . 13
M'Culloch's Geographical Dictionary . 15
Maunder's Treasury of Geography . 16
Murray's Encyclopædia of Geography . 17
Sharp's British Gazetteer . . . 21

## Juvenile Books.

Amy Herbert . . . . . . . 20
Cleve Hall . . . . . . . 20
Earl's Daughter (The) . . . . 20
Experience of Life . . . . . 20
Gertrude . . . . . . . . 20
Howitt's Boy's Country Book . . 12
“ (Mary) Children's Year . . 12
Ivors . . . . . . . . . 20
Katharine Ashton . . . . . 20
Laneton Parsonage . . . . 20
Margaret Percival . . . . . 20
Pycroft's Collegian's Guide . . . 19

## Medicine, Surgery, &c.

Brodie's Psychological Inquiries . . 7
Bull's Hints to Mothers . . . . 6
“ Management of Children . . 6
Copland's Dictionary of Medicine . . 8
Cust's Invalid's Own Book . . . 9
Holland's Mental Physiology . . . 11
“ Medical Notes and Reflections 11
How to Nurse Sick Children . . . 12
Kesteven's Domestic Medicine . . 13
Pereira's Materia Medica . . . 18
Reece's Medical Guide . . . . 19
Richardson's Cold-water Cure . . 19
Spencer's Principles of Psychology . 21
West on Diseases of Infancy . . . 24

## Miscellaneous Literature.

Bacon's (Lord) Works . . . . 5
Defence of *Eclipse of Faith* . . . 9
Eclipse of Faith . . . . . . 9
Greathed's Letters from Delhi . . 10
Greyson's Select Correspondence . . 10
Gurney's Evening Recreations . . 10
Hassall's Adulterations Detected, &c. . 11
Haydn's Book of Dignities . . . 11
Holland's Mental Physiology . . 11

Hooker's Kew Guides . . . . 11
Howitt's Rural Life of England . . 12
" Visits to Remarkable Places . 12
Jameson's Commonplace-Book . . 13
Jeffrey's (Lord) Contributions . . 13
Last of the Old Squires . . . . 18
Letters of a Betrothed . . . . 13
Macaulay's Critical and Hist. Essays . 14
" Speeches . . . . 14
Mackintosh's Miscellaneous Works . 15
Martineau's Miscellanies . . . 15
Pycroft's English Reading . . . 19
Raikes on the Indian Revolt . . . 19
Rees's Siege of Lucknow . . . 19
Rich's Companion to Latin Dictionary 19
Riddle's Latin Dictionaries . . . 19
Rowton's Debater . . . . . 20
Seaward's Narrative of his Shipwreck . 20
Sir Roger De Coverley . . . . 21
Smith's (Rev. Sydney) Works . . 21
Southey's Doctor, &c. . . . . 21
Spencer's Essays . . . . . 21
Stephen's Essays . . . . . 22
Stow's Training System . . . . 22
Thomson's Laws of Thought . . 22
Tighe and Davis's Windsor . . . 22
Townsend's State Trials . . . . 22
Yonge's English-Greek Lexicon . . 24
" Latin Gradus . . . . 24
Zumpt's Latin Grammar . . . 24

### Natural History in general.

Catlow's Popular Conchology . . 8
Ephemera's Book of the Salmon . . 9
Garratt's Marvels of Instinct . . . 10
Gosse's Natural History of Jamaica . 10
Kirby and Spence's Entomology . 13
Lee's Elements of Natural History . 13
Maunder's Natural History . . . 16
Quatrefages' Rambles of a Naturalist . 19
Turton's Shells of the British Islands . 23
Van der Hoeven's Handbook of Zoology 23
Waterton's Essays on Natural History . 24
Youatt's The Dog . . . . 24
" The Horse . . . . 24

### One-Volume Encyclopædias and Dictionaries.

Blaine's Rural Sports . . . . 6
Brande's Science, Literature, and Art . 6
Copland's Dictionary of Medicine . 8
Cresy's Civil Engineering . . . 8
Gwilt's Architecture . . . . 10
Johnston's Geographical Dictionary . 13
Loudon's Agriculture . . . . 14
" Rural Architecture . . 14
" Gardening . . . . 14
" Plants . . . . . 14
" Trees and Shrubs . . . 14
M'Culloch's Geographical Dictionary . 15
" Dictionary of Commerce . 15
Murray's Encyclopædia of Geography . 17
Sharp's British Gazetteer . . . 21
Ure's Dictionary of Arts, &c. . . . 23
Webster's Domestic Economy . . 24

### Religious and Moral Works.

Amy Herbert . . . . . . . 20
Bloomfield's Greek Testament . . 6
Calvert's Wife's Manual . . . . 8
Cleve Hall . . . . . . . 20
Conybeare and Howson's St. Paul . 8
Cotton's Instructions in Christianity . 8
Dale's Domestic Liturgy . . . 9
Defence of *Eclipse of Faith* . . . 9
Earl's Daughter (The) . . . . 20
Eclipse of Faith . . . . . 9
Englishman's Greek Concordance . 9
" Heb. & Chald. Concord. 9
Experience (The) of Life . . . 20
Gertrude . . . . . . 20
Harrison's Light of the Forge . . 10
Horne's Introduction to Scriptures . 11
" Abridgment of ditto . . 11
Huc's Christianity in China . . . 12
Humphreys's *Parables* Illuminated . 12
Ivors, by the Author of *Amy Herbert* . 20
Jameson's Saints and Martyrs . . 12
" Monastic Legends . . 13
" Legends of the Madonna . 13
" on Female Employment . . 13
Jeremy Taylor's Works . . . . 13
Katharine Ashton . . . . . 21
König's Pictorial Life of Luther . . 10
Laneton Parsonage . . . . . 20
Letters to my Unknown Friends . . 13
" on Happiness . . . . 13
Lyra Germanica . . . . . 7
Maguire's Rome . . . . . 15
Margaret Percival . . . . . 20
Martineau's Christian Life . . . 15
" Hymns . . . . 15
" Studies of Christianity . 15
Merivale's Christian Records . . 16
Milner's Church of Christ . . . 26
Moore on the Use of the Body . . 26
" " Soul and Body . . 26
" 's Man and his Motives . . 26
Morning Clouds . . . . . 17
Neale's Closing Scene . . . . 18
Pattison's Earth and Word . . . 18
Powell's Christianity without Judaism . 19
Readings for Lent . . . . . 20
" Confirmation . . . 20
Riddle's Household Prayers . . . 19
Robinson's Lexicon to the Greek Testament . . . . . . . . 20
Saints our Example . . . . 20
Sermon in the Mount . . . . 20
Sinclair's Journey of Life . . . 21
Smith's (Sydney) Moral Philosophy . 21
" (G.V.) Assyrian Prophecies . 21
" (G.) Wesleyan Methodism . 21
" (J.) Shipwreck of St. Paul . 21
Southey's Life of Wesley . . . 21
Stephen's Ecclesiastical Biography . 22
Taylor's Loyola . . . . . 22
" Wesley . . . . . 22
Theologia Germanica . . . . 7
Thumb Bible (The) . . . . 22
Turner's Sacred History . . . . 23
Young's Christ of History . . . 24
" Mystery . . . . . 24

### Poetry and the Drama.

Aikin's (Dr.) British Poets . . . 5
Arnold's Merope . . . . . 5
" Poems . . . . . 5
Baillie's (Joanna) Poetical Works . . 5
Calvert's Wife's Manual . . . . 8
Goldsmith's Poems, illustrated . . 10
Horace, edited by Yonge . . . 24
L. E. L.'s Poetical Works . . . 13
Linwood's Anthologia Oxoniensis . 14

Lyra Germanica 7
Macaulay's Lays of Ancient Rome 14
MacDonald's Within and Without 15
" Poems 14
Montgomery's Poetical Works 20
Moore's Poetical Works 26
" Selections (illustrated) 26
" Lalla Rookh 17
" Irish Melodies 17
" National Melodies 17
" Sacred Songs (*with Music*) 17
" Songs and Ballads 16
Reade's Poetical Works 19
Shakspeare, by Bowdler 20
Southey's Poetical Works 21
Thomson's Seasons, illustrated 22

## Political Economy & Statistics.

Macleod's Political Economy 15
M'Culloch's Geog. Statist. &c. Dict. 15
" Dictionary of Commerce 15
Willich's Popular Tables 24

## The Sciences in general and Mathematics.

Arago's Meteorological Essays 5
" Popular Astronomy 5
Bourne on the Screw Propeller 6
" 's Catechism of Steam-Engine 6
Boyd's Naval Cadet's Manual 6
Brande's Dictionary of Science, &c. 6
" Lectures on Organic Chemistry 6
Cresy's Civil Engineering 8
Delabeche's Geology of Cornwall, &c. 9
De la Rive's Electricity 9
Grove's Correlation of Physical Forces 10
Herschel's Outlines of Astronomy 11
Holland's Mental Physiology 11
Humboldt's Aspects of Nature 12
" Cosmos 12
Hunt on Light 12
Lardner's Cabinet Cyclopædia 13
Marcet's (Mrs.) Conversations 15
Morell's Elements of Psychology 17
Moseley's Engineering and Architecture 17
Ogilvie's Master-Builder's Plan 18
Owen's Lectures on Comp. Anatomy 18
Pereira on Polarised Light 18
Peschel's Elements of Physics 18
Phillips's Fossils of Cornwall 18
" Mineralogy 18
" Guide to Geology 18
Portlock's Geology of Londonderry 18
Powell's Unity of Worlds 19
" Christianity without Judaism 19
Smee's Electro-Metallurgy 21
Steam-Engine (The) 6

## Rural Sports.

Baker's Rifle and Hound in Ceylon 5
Blaine's Dictionary of Sports 6
Cecil's Stable Practice 8
" Stud Farm 8
Davy's Fishing Excursions, 2 Series 9
Ephemera on Angling 9
" Book of the Salmon 9
Hawker's Young Sportsman 11
The Hunting-Field 10
Idle's Hints on Shooting 12
Pocket and the Stud 10
Practical Horsemanship 10
Pycroft's Cricket-Field 9
Rarey's Horse-Taming 19
Richardson's Horsemanship 19
Ronalds's Fly-Fisher's Entomology 20
Stable Talk and Table Talk 10
Stonehenge on the Dog 22
" " Greyhound 22
Thacker's Courser's Guide 22
The Stud, for Practical Purposes 10

## Veterinary Medicine, &c.

Cecil's Stable Practice 8
" Stud Farm 8
Hunting-Field (The) 10
Miles's Horse-Shoeing 26
" on the Horse's Foot 26
Pocket and the Stud 10
Practical Horsemanship 10
Rarey's Horse-Taming 19
Richardson's Horsemanship 19
Stable Talk and Table Talk 10
Stonehenge on the Dog 22
Stud (The) 10
Youatt's The Dog 24
" The Horse 24

## Voyages and Travels.

Baker's Wanderings in Ceylon 5
Barth's African Travels 5
Burton's East Africa 7
" Medina and Mecca 7
Davies's Visit to Algiers 9
Domenech's Texas and Mexico 9
Forester's Sardinia and Corsica 10
Hinchliff's Travels in the Alps 11
Howitt's Art-Student in Munich 12
" (W.) Victoria 12
Huc's Chinese Empire 12
Hudson and Kennedy's Mont Blanc 12
Humboldt's Aspects of Nature 12
Hutchinson's Western Africa 12
M'Clure's North-West Passage 18
Mac Dougall's Voyage of the *Resolute* 15
Osborn's Quedah 18
Scherzer's Central America 20
Seaward's Narrative 20
Snow's Tierra del Fuego 21
Von Tempsky's Mexico and Guatemala 23
Wanderings in the Land of Ham 24
Weld's Vacations in Ireland 24
" United States and Canada 24

## Works of Fiction.

Cruikshank's Falstaff 9
Heirs of Cheveleigh 11
Howitt's Tallangetta 12
Moore's Epicurean 17
Sir Roger De Coverley 21
Sketches (The), Three Tales 21
Southey's Doctor, &c. 21
Trollope's Barchester Towers 22
" Warden 22
Ursula 20

ALPHABETICAL CATALOGUE

of

# NEW WORKS and NEW EDITIONS

PUBLISHED BY

LONGMAN, BROWN, GREEN, LONGMANS, & ROBERTS,

PATERNOSTER ROW, LONDON.

---

**Miss Acton's Modern Cookery** for Private Families, reduced to a System of Easy Practice in a Series of carefully-tested Receipts, in which the Principles of Baron Liebig and other eminent writers have been as much as possible applied and explained. Newly-revised and enlarged Edition; with 8 Plates, comprising 27 Figures, and 150 Woodcuts. Fcp. 8vo. 7s. 6d.

**Acton's English Bread-Book for** Domestic Use, adapted to Families of every grade. Fcp. 8vo. price 4s. 6d.

**Aikin's Select Works of the** British Poets from Ben Jonson to Beattie. New Edition; with Biographical and Critical Prefaces, and Selections from recent Poets. 8vo. 18s.

**Arago (F.)—Biographies of Distinguished** Scientific Men. Translated by Admiral W. H. SMYTH, D.C.L., F.R.S., &c.; the Rev. BADEN POWELL, M.A.; and ROBERT GRANT, M.A., F.R.A.S. 8vo. 18s.

**Arago's Meteorological Essays.** With an Introduction by BARON HUMBOLDT. Translated under the superintendence of Lieut.-Col. E. SABINE, R.A., Treasurer and V.P.R.S. 8vo. 18s.

**Arago's Popular Astronomy.** Translated and edited by Admiral W. H. SMYTH, D.C.L., F.R.S.; and ROBERT GRANT, M.A., F.R.A.S. In Two Volumes. VOL. I. 8vo. with Plates and Woodcuts, 21s.—VOL. II. is in the press.

**Arnold. — Merope, a Tragedy.** By MATTHEW ARNOLD. With a Preface and an Historical Introduction. Fcp. 8vo. 5s.

**Arnold.—Poems. By Matthew** ARNOLD. FIRST SERIES, Third Edition. Fcp. 8vo. 5s. 6d. SECOND SERIES, price 5s.

**Lord Bacon's Works. A New** Edition, collected and edited by R. L. ELLIS, M.A., Fellow of Trinity College, Cambridge; J. SPEDDING, M.A. of Trinity College, Cambridge; and D. D. HEATH, Esq., Barrister-at-Law, and late Fellow of Trinity College, Cambridge. VOLS I. to III. 8vo. 18s. each; VOL. IV. 14s.; and VOL. V. 18s. comprising the Division of *Philosophical Works;* with a copious INDEX.

VOLS. VI. and VII. comprise BACON'S *Literary and Professional Works.* VOL. VI. price 18s. now ready.

**Joanna Baillie's Dramatic and** Poetical Works: Comprising Plays of the Passions, Miscellaneous Dramas, Metrical Legends, Fugitive Pieces, and Ahalya Baee; with the Life of Joanna Baillie, Portrait and Vignette. Square crown 8vo. 21s. cloth; or 42s. morocco.

**Baker.—The Rifle and the Hound** in Ceylon. By S. W. BAKER, Esq. New Edition, with 13 Illustrations engraved on Wood. Fcp. 8vo. 4s. 6d.

**Baker. — Eight Years' Wanderings** in Ceylon. By S. W. BAKER, Esq. With 6 coloured Plates. 8vo. 15s.

**Barth.—Travels and Discoveries** in North and Central Africa: Being the Journal of an Expedition undertaken under the auspices of Her Britannic Majesty's Government in the Years 1849—1855. By HENRY BARTH, Ph.D., D.C.L., &c. With numerous Maps and Illustrations. 5 vols. 8vo. £5. 5s. cloth.

**Bayldon's Art of Valuing Rents** and Tillages, and Claims of Tenants upon Quitting Farms, at both Michaelmas and Lady-day; as revised by Mr DONALDSON. *Seventh Edition,* enlarged and adapted to the Present Time. By ROBERT BAKER, Land Agent and Valuer. 8vo. price 10s. 6d.

**Black's Practical Treatise on** Brewing, based on Chemical and Economical Principles: With Formulæ for Public Brewers, and Instructions for Private Families. 8vo. 10s. 6d.

**Blaine's Encyclopædia of Rural** Sports; or, a complete Account, Historical, Practical, and Descriptive, of Hunting, Shooting, Fishing, Racing, &c. *New Edition*, revised and corrected to the Present Time; with above 600 Woodcut Illustrations, including 20 Subjects now added from Designs by John Leech.

**Blair's Chronological and Historical** Tables, from the Creation to the Present Time: With Additions and Corrections from the most authentic Writers; including the Computation of St. Paul, as connecting the Period from the Exode to the Temple. Under the revision of Sir HENRY ELLIS, K.H. Imperial 8vo. 31s. 6d. half-morocco.

**Boyd. — A Manual for Naval** Cadets. Published with the sanction and approval of the Lords Commissioners of the Admiralty. By JOHN M'NEILL BOYD, Captain, R.N. With Compass-Signals in Colours, and 236 Woodcuts. Fcp. 8vo. 10s. 6d.

**Bloomfield.—The Greek Testament:** with copious English Notes, Critical, Philological, and Explanatory. Especially adapted to the use of Theological Students and Ministers. By the Rev. S. T. BLOOMFIELD, D.D., F.S.A. Ninth Edition, revised. 2 vols. 8vo. with Map, £2. 8s.

**Dr. Bloomfield's College & School** Edition of the Greek Testament: With brief English Notes, chiefly Philological and Explanatory. Seventh Edition; with Map and Index. Fcp. 8vo. 7s. 6d.

**Dr. Bloomfield's College & School** Lexicon to the Greek Testament. New Edition, revised. Fcp. 8vo. price 10s. 6d.

**Bourne's Catechism of the Steam** Engine in its various Applications to Mines, Mills, Steam Navigation, Railways, and Agriculture: With Practical Instructions for the Manufacture and Management of Engines of every class. Fourth Edition, enlarged; with 89 Woodcuts. Fcp. 8vo. 6s.

**Bourne. — A Treatise on the** Steam Engine, in its Application to Mines, Mills, Steam Navigation, and Railways. By the Artisan Club. Edited by JOHN BOURNE, C.E. New Edition; with 33 Steel Plates, and 349 Wood Engravings. 4to. 27s.

**Bourne. — A Treatise on the** Screw Propeller: With various Suggestions of Improvement. By JOHN BOURNE, C.E. New Edition, with 20 large Plates and numerous Wood Engravings. 4to. 38s.

**Brande's Dictionary of Science,** Literature, and Art; comprising the History, Description, and Scientific Principles of every Branch of Human Knowledge; with the Derivation and Definition of all the Terms in general use. Third Edition, revised and corrected; with numerous Woodcuts. 8vo. 60s.

**Professor Brande's Lectures on** Organic Chemistry, as applied to Manufactures, including Dyeing, Bleaching, Calico Printing, Sugar Manufacture, the Preservation of Wood, Tanning, &c. Edited by J. SCOFFERN, M.B. Fcp. Woodcuts, 7s. 6d.

**Brewer.—An Atlas of History** and Geography, from the Commencement of the Christian Era to the Present Time: Comprising a Series of Sixteen Coloured Maps, arranged in Chronological Order, with Illustrative Memoirs. By the Rev. J. S. BREWER, M.A. *Second Edition*, revised and corrected. Royal 8vo. 12s. 6d. half-bound.

**Brialmont. — The Life of the** Duke of Wellington. From the French of ALEXIS BRIALMONT, Captain on the Staff of the Belgian Army: With Emendations and Additions. By the Rev. G. R. GLEIG, M.A., Chaplain-General to the Forces and Prebendary of St. Paul's. With Maps, Plans, and Portraits. VOLS. I. and II. 8vo. price 30s.
VOL. III. (*completion*) is in preparation.

**Dr. T. Bull's Hints to Mothers on** the Management of their Health during the Period of Pregnancy and in the Lying-in Room: With an Exposure of Popular Errors in connexion with those subjects, &c.; and Hints upon Nursing. New Edition. Fcp. 8vo. 5s.

**Bull. — The Maternal Management** of Children in Health and Disease. By T. BULL, M.D., formerly Physician-Accoucheur to the Finsbury Midwifery Institution. New Edition. Fcp. 8vo. 5s.

**Brodie.—Psychological Inquiries**, in a Series of Essays intended to illustrate the Influence of the Physical Organisation on the Mental Faculties. By Sir BENJAMIN C. BRODIE, Bart. Third Edition. Fcp. 8vo. 5s.

**Bunsen.—Christianity and Mankind**, their Beginnings and Prospects. By Baron C. C. J. BUNSEN, D.D., D.C.L., D.Ph. Being a New Edition, corrected, re-modelled, and extended, of *Hippolytus and his Age*. 7 vols. 8vo. £5. 5s.

*** This Edition is composed of three distinct works, as follows:—

1. Hippolytus and his Age; or, the Beginnings and Prospects of Christianity. 2 vols. 8vo. £1. 10*s.*
2. Outline of the Philosophy of Universal History applied to Language and Religion; containing an Account of the Alphabetical Conferences. 2 vols. 33*s.*
3. Analecta Ante-Nicæna. 3 vols. 8vo. £2. 2*s.*

**Bunsen. — Lyra Germanica.** Translated from the German by CATHERINE WINKWORTH. *Fifth Edition* of the FIRST SERIES, Hymns for the Sundays and Festivals of the Christian Year. SECOND SERIES, the Christian Life. Fcp. 8vo. 5s. each Series.

*** These selections of German Hymns have been made from collections published in Germany by Baron BUNSEN; and form companion volumes to

**Theologia Germanica: Which** setteth forth many fair lineaments of Divine Truth, and saith very lofty and lovely things touching a Perfect Life. Translated by SUSANNA WINKWORTH. With a Preface by the Rev. CHARLES KINGSLEY; and a Letter by Baron BUNSEN. Third Edition. Fcp. 8vo. 5s.

**Bunsen.—Egypt's Place in Universal History**: An Historical Investigation, in Five Books. By Baron C. C. J. BUNSEN, D.C.L., D.Ph. Translated from the German by C. H. COTTRELL, Esq., M.A. With many Illustrations. VOL. I. 8vo. 28s.; VOL. II. 8vo. 30s. VOLS. III. IV. and V. completing the work, are in the press.

**Bishop Butler's Sketch of Modern** and Ancient Geography. New Edition, thoroughly revised, with such Alterations introduced as continually progressive Discoveries and the latest information have rendered necessary. Post 8vo. 7s. 6d.

**Bishop Butler's General Atlas** of Modern and Ancient Geography; comprising Fifty-two full-coloured Maps; with complete Indices. New Edition, enlarged, and greatly improved. Edited by the Author's Son. Royal 4to. 24s.

**Burton.—First Footsteps in East** Africa; or, an Exploration of Harar. By RICHARD F. BURTON, Captain, Bombay Army. With Maps and coloured Plate. 8vo. 18s.

**Burton.—Personal Narrative of** a Pilgrimage to El Medinah and Meccah. By RICHARD F. BURTON, Captain, Bombay Army. *Second Edition*, revised; with coloured Plates and Woodcuts. 2 vols. crown 8vo. 24s.

**The Cabinet Lawyer: A Popular** Digest of the Laws of England, Civil and Criminal; with a Dictionary of Law Terms, Maxims, Statutes, and Judicial Antiquities; Correct Tables of Assessed Taxes, Stamp Duties, Excise Licenses, and Post-Horse Duties; Post-Office Regulations; and Prison Discipline. 17th Edition, comprising the Public Acts of the Session 1858. Fcp. 8vo. 10s. 6d.

**The Cabinet Gazetteer: A Popular** Exposition of All the Countries of the World. By the Author of *The Cabinet Lawyer*. Fcp. 8vo. 10s. 6d.

**Calendars of State Papers, Domestic** Series, published under the Direction of the Master of the Rolls, and with the Sanction of H.M. Secretary of State for the Home Department:

The Reign of JAMES I. 1603-23, edited by Mrs. GREEN. VOLS. I. to III. imperial 8vo. 15s. each.

The Reign of CHARLES I. 1625-26, edited by JOHN BRUCE, V.P.S.A. Imperial 8vo. 15s.

The Reigns of EDWARD VI., MARY, ELIZABETH, 1547-80, edited by R. LEMON, Esq. Imperial 8vo. 15s.

Historical Notes relative to the History of England, from the Accession of HENRY VIII. to the Death of ANNE (1509-1714), compiled by F. S. THOMAS, Esq. 3 vols. imperial 8vo. 40s.

State Papers relating to SCOTLAND, from the Reign of HENRY VIII. to the Accession of JAMES I. (1509-1603), and of the Correspondence relating to MARY QUEEN of SCOTS, during her Captivity in England, edited by M. J. THORPE, Esq. 2 vols. imperial 8vo. 30s.

**Calvert. — The Wife's Manual;** or, Prayers, Thoughts, and Songs on Several Occasions of a Matron's Life. By the Rev. W. CALVERT, M.A. Ornamented from Designs by the Author in the style of *Queen Elizabeth's Prayer-Book*. Crown 8vo. 10s. 6d.

**Catlow's Popular Conchology;** or, the Shell Cabinet arranged according to the Modern System: With a detailed Account of the Animals, and a complete Descriptive List of the Families and Genera of Recent and Fossil Shells. Second Edition, improved; with 405 Woodcuts. Post 8vo. 14s.

**Cecil. — The Stud Farm;** or, Hints on Breeding Horses for the Turf, the Chase, and the Road. Addressed to Breeders of Race-Horses and Hunters, Landed Proprietors, and Tenant Farmers. By CECIL. Fcp. 8vo. 5s.

**Cecil's Stable Practice; or, Hints** on Training for the Turf, the Chase, and the Road; with Observations on Racing and Hunting, Wasting, Race-Riding, and Handicapping: Addressed to all who are concerned in Racing, Steeple-Chasing, and Fox-Hunting. Fcp. 8vo. with Plate, 5s.

**Chronicles and Memorials of** Great Britain and Ireland during the Middle Ages, published by the authority of H. M. Treasury under the Direction of the Master of the Rolls :—

Capgrave's Chronicle of England, edited by the Rev. F. C. HINGESTON, M.A. Royal 8vo. 8s. 6d.

Chronicon Monasterii de Abingdon, edited by the Rev. J. STEVENSON, M.A. VOL. I. royal 8vo. 8s. 6d.

Lives of Edward the Confessor, edited by the Rev. H. R. LUARD, M.A. 8s. 6d.

Monumenta Franciscana, edited by the Rev. J. S. BREWER, M.A. 8s. 6d.

Fasciculi Zizaniorum Magistri Johannis Wyclif cum Tritico, edited by the Rev. W. W. SHIRLEY, M.A. 8s. 6d.

Stewart's Buik of the Cronicilis of Scotland, edited by W. B. TURNBULL, Barrister. VOL. I. royal 8vo. 8s. 6d.

Johannis Capgrave Liber de Illustribus Henricis, edited by the Rev. F. C. HINGESTON, M.A. Royal 8vo. 8s. 6d.

English Translation of Capgrave's *Book of the Illustrious Henries*, by the Rev. F. C. HINGESTON, M.A. 10s. 6d.

Elmham's Historia de Monasterii S. Augustini Cantuarensis, edited by the v. C. HARDWICKE, M.A. 8s. 6d.

**Chapman.—History of Gustavus** Adolphus, and of the Thirty Years' War up to the King's Death: With some Account of its Conclusion by the Peace of Westphalia, in 1648. By B. CHAPMAN, M.A. 8vo. Plans, 12s. 6d.

**Chevreul On the Harmony and** Contrast of Colours, and their Applications to the Arts: Including Painting, Interior Decoration, Tapestries, Carpets, Mosaics, Coloured Glazing, Paper-Staining, Calico-Printing, Letterpress-Printing, Map-Colouring, Dress, Landscape and Flower-Gardening, &c. &c. Translated by CHARLES MARTEL. With 4 Plates. Crown 8vo. 10s. 6d.

**Connolly.—History of the Royal** Sappers and Miners: Including the Services of the Corps in the Crimea and at the Siege of Sebastopol. By T. W. J. CONNOLLY, Quartermaster of the Royal Engineers. *Second Edition;* with 17 coloured Plates. 2 vols. 8vo. 30s.

**Conybeare and Howson's Life** and Epistles of Saint Paul: Comprising a complete Biography of the Apostle, and a Translation of his Epistles inserted in Chronological Order. *Third Edition*, revised and corrected; with several Maps and Woodcuts, and 4 Plates. 2 vols. square crown 8vo. 31s. 6d.

*** The Original Edition, with more numerous Illustrations, in 2 vols. 4to. price 48s. —may also be had.

**Dr. Copland's Dictionary of** Practical Medicine: Comprising General Pathology, the Nature and Treatment of Diseases, Morbid Structures, and the Disorders especially incidental to Climates, to Sex, and to the different Epochs of Life; with numerous approved Formulæ of the Medicines recommended. Now complete in 3 vols. 8vo. price £5. 11s. cloth.

**Bishop Cotton's Instructions in** the Doctrine and Practice of Christianity. Intended as an Introduction to Confirmation. 4th Edition. 18mo. 2s. 6d.

**Cresy's Encyclopædia of Civil** Engineering, Historical, Theoretical, and Practical. Illustrated by upwards of 3,000 Woodcuts. *Second Edition*, revised; and extended in a Supplement, comprising Metropolitan Water-Supply, Drainage of Towns, Railways, Cubical Proportion, Brick and Iron Construction, Iron Screw Piles, Tubular Bridges, &c. 8vo. 63s.

**Crosse. — Memorials, Scientific** and Literary, of Andrew Crosse, the Electrician. Edited by Mrs. Crosse. Post 8vo. 9s. 6d.

**Crowe.—The History of France.** By Eyre Evans Crowe. In Five Volumes. Vol. I. 8vo. 14s.

**Cruikshank. — The Life of Sir** John Falstaff, illustrated in a Series of Twenty-four original Etchings by George Cruikshank. Accompanied by an imaginary Biography of the Knight, by Robert B. Brough. Royal 8vo. price 12s. 6d. cloth.

**Lady Cust's Invalid's Own Book:** A Collection of Recipes from various Books and various Countries. *Second Edition.* Fcp. 8vo. 2s. 6d.

**The Rev. Canon Dale's Domestic** Liturgy and Family Chaplain, in Two Parts: Part I. Church Services adapted for Domestic Use, with Prayers for Every Day of the Week, selected from the Book of Common Prayer; Part II. an appropriate Sermon for Every Sunday in the Year. Second Edition. Post 4to. 21s. cloth; 31s. 6d. calf; or £2. 10s. morocco.

Separately { The Family Chaplain, 12s.
The Domestic Liturgy, 10s. 6d.

**Davies.—Algiers in 1857: Its** Accessibility, Climate, and Resources described with especial reference to English Invalids; with details of Recreation obtainable in its Neighbourhood added for the use of Travellers in general. By the Rev. E. W. L. Davies, M.A. Oxon. Post 8vo. 6s.

**Delabeche.—Report on the Geology** of Cornwall, Devon, and West Somerset. By Sir H. T. Delabeche, F.R.S. With Maps, Plates, and Woodcuts. 8vo. 14s.

**Davy (Dr. J.)—The Angler and** his Friend; or, Piscatory Colloquies and Fishing Excursions. By John Davy, M.D., F.R.S., &c. Fcp. 8vo. 6s.

*By the same Author,*

**The Angler in the Lake District;** or, Piscatory Colloquies and Fishing Excursions in Westmoreland and Cumberland. Fcp. 8vo. 6s. 6d.

**De la Rive's Treatise on Electricity** in Theory and Practice. Translated for the Author by C. V. Walker, F.R.S. 3 vols. 8vo. Woodcuts, £3. 13s.

**Abbe' Domenech's Missionary** Adventures in Texas and Mexico: A Personal Narrative of Six Years' Sojourn in those Regions. Translated from the French under the Author's superintendence. 8vo. 10s. 6d.

**The Eclipse of Faith; or, a Visit** to a Religious Sceptic. *9th Edition.* Fcp. 8vo. 5s.

**Defence of The Eclipse of Faith,** by its Author: Being a Rejoinder to Professor Newman's *Reply:* Including a full Examination of that Writer's Criticism on the Character of Christ; and a Chapter on the Aspects and Pretensions of Modern Deism. *Second Edition,* revised. Post 8vo. 5s. 6d.

**The Englishman's Greek Concordance** of the New Testament: Being an Attempt at a Verbal Connexion between the Greek and the English Texts; including a Concordance to the Proper Names, with Indexes, Greek-English and English-Greek. New Edition, with a new Index. Royal 8vo. 42s.

**The Englishman's Hebrew and** Chaldee Concordance of the Old Testament: Being an Attempt at a Verbal Connexion between the Original and the English Translations; with Indexes, a List of the Proper Names and their Occurrences, &c. 2 vols. royal 8vo. £3. 13s. 6d.; large paper, £4. 14s. 6d.

**Ephemera's Handbook of Angling;** teaching Fly-fishing, Trolling, Bottom-Fishing, Salmon-Fishing: With the Natural History of River-Fish, and the best Modes of Catching them. Third Edition, corrected and improved; with Woodcuts. Fcp. 8vo. 5s.

**Ephemera's Book of the Salmon:** The Theory, Principles, and Practice of Fly-Fishing for Salmon; Lists of good Salmon Flies for every good River in the Empire; the Natural History of the Salmon, its Habits described, and the best way of artificially Breeding it. Fcp. 8vo. with coloured Plates, 14s.

**Fairbairn.—Useful Information** for Engineers: Being a Series of Lectures delivered to the Working Engineers of Yorkshire and Lancashire. By William Fairbairn, F.R.S., F.G.S. *Second Edition;* with Plates and Woodcuts. Crown 8vo. 10s. 6d.

**Fischer. — Francis Bacon of** Verulam: Realistic Philosophy and its Age. By Dr. K. Fischer. Translated by John Oxenford. Post 8vo. 9s. 6d.

**Forester. — Rambles in the** Islands of Corsica and Sardinia: With Notices of their History, Antiquities, and present Condition. By THOMAS FORESTER. With coloured Map; and numerous Lithographic and Woodcut Illustrations from Drawings made during the Tour by Lieut.-Col. M. A. Biddulph, R.A. Imperial 8vo. 28s.

**Garratt.—Marvels and Mysteries** of Instinct; or, Curiosities of Animal Life. By GEORGE GARRATT. *Second Edition*, improved. Fcp. 8vo. 4s. 6d.

**Gilbart. — A Practical Treatise** on Banking. By JAMES WILLIAM GILBART, F.R.S., General Manager of the London and Westminister Bank. *Sixth Edition.* 2 vols. 12mo. 16s.

**Gilbart.—Logic for the Million:** a Familiar Exposition of the Art of Reasoning, By J. W. GILBART, F.R.S. 5th Edition; with Portrait. 12mo. 3s. 6d.

**Gleig.—Essays, Biographical,** Historical, and Miscellaneous, contributed chiefly to the *Edinburgh* and *Quarterly Reviews.* By the Rev. G. R. GLEIG, M.A., Chaplain-General to the Forces, and Prebendary of St. Paul's. 2 vols. 8vo. price 21s.

**The Poetical Works of Oliver** Goldsmith. Edited by BOLTON CORNEY, Esq. Illustrated by Wood Engravings, from Designs by Members of the Etching Club. Square crown 8vo. cloth, 21s.; morocco, £1. 16s.

**Gosse.—A Naturalist's Sojourn** in Jamaica. By P. H. GOSSE, Esq. With Plates. Post 8vo. 14s.

**Greathed.—Letters from Delhi** during the Siege. By H. H. GREATHED, Esq., Political Agent. Post 8vo.

**Green.—Lives of the Princesses** of England. By Mrs. MARY ANNE EVERETT GREEN, Editor of the *Letters of Royal and Illustrious Ladies.* With numerous Portraits. Complete in 6 vols. post 8vo. 10s. 6d. each.

**Greyson.—Selections from the** Correspondence of R. E. GREYSON, Esq. Edited by the Author of *The Eclipse of Faith.* New Edition. Crown 8vo. 7s. 6d.

**Grove.—The Correlation of Physical** Forces. By W. R. GROVE, Q.C., M.A. *Third Edition.* 8vo. 7s.

**Gurney.—St. Louis and Henri** IV.: Being a Second Series of Historical Sketches. By the Rev. JOHN H. GURNEY, M.A. Fcp. 8vo. 6s.

**Evening Recreations; or, Samples** from the Lecture-Room. Edited by Rev. J. H. GURNEY. Crown 8vo. 5s.

**Gwilt's Encyclopædia of Architecture,** Historical, Theoretical, and Practical. By JOSEPH GWILT. With more than 1,000 Wood Engravings, from Designs by J. S. GWILT. 8vo. 42s.

**Hare (Archdeacon).—The Life** of Luther, in Forty-eight Historical Engravings. By GUSTAV KÖNIG. With Explanations by Archdeacon HARE and SUSANNAH WINKWORTH. Fcp. 4to. 28s.

**Harford.—Life of Michael Angelo** Buonarroti: With Translations of many of his Poems and Letters; also Memoirs of Savonarola, Raphael, and Vittoria Colonna. By JOHN S. HARFORD, Esq., D.C.L., F.R.S. Second Edition, revised; with 20 Plates. 2 vols. 8vo. 25s.

**Illustrations, Architectural and** Pictorical, of the Genius of Michael Angelo Buonarroti. With Descriptions of the Plates, by the Commendatore CANINA; C. R. COCKERELL, Esq., R.A.; and J. S. HARFORD, Esq., D.C.L., F.R.S. Folio, 73s. 6d. half-bound.

**Harrison. — The Light of the** Forge; or, Counsels from the Sick-Bed of E.M. By the Rev. W. HARRISON, M.A., Domestic Chaplain to the Duchess of Cambridge. Fcp. 8vo. 5s.

**Harry Hieover's Stable Talk** and Table Talk; or, Spectacles for Young Sportsmen. New Edition, 2 vols. 8vo. Portrait, 24s.

**Harry Hieover.—The Hunting-**Field. By HARRY HIEOVER. With Two Plates. Fcp. 8vo. 5s. half-bound.

**Harry Hieover. — Practical** Horsemanship. *Second Edition;* with 2 Plates. Fcp. 8vo. 5s. half-bound.

**Harry Hieover.—The Pocket and** the Stud; or, Practical Hints on the Management of the Stable. By HARRY HIEOVER. Fcp. 8vo. Portrait, 5s.

**Harry Hieover.—The Stud, for** Practical Purposes and Practical Men: Being a Guide to the Choice of a Horse for use more than for show. Fcp. 5s.

**Hassall.—A History of the British Freshwater Algæ**: Including Descriptions of the Desmideæ and Diatomaceæ. By ARTHUR HILL HASSALL, M.D. 2 vols. 8vo. with 103 Plates, £1. 15s.

**Hassall.—Adulterations Detected**; or, Plain Instructions for the Discovery of Frauds in Food and Medicine. By ARTHUR HILL HASSALL, M.D. Lond., Analyst of *The Lancet* Sanitary Commission, and Author of the Reports of that Commission published under the title of *Food and its Adulterations* (which may also be had, in 8vo. price 28s.) With 225 Illustrations, engraved on Wood. Crown 8vo. 17s. 6d.

**Col. Hawker's Instructions to** Young Sportsmen in all that relates to Guns and Shooting. 10th Edition, revised by the Author's Son, Major P. W. L. HAWKER. With Portrait, Plates, and Woodcuts. 8vo. 21s.

**Haydn's Book of Dignities**: Containing Rolls of the Official Personages of the British Empire, Civil, Ecclesiastical, Judicial, Military, Naval, and Municipal, from the Earliest Periods to the Present Time. Together with the Sovereigns of Europe, from the Foundation of their respective States; the Peerage and Nobility of Great Britain, &c. 8vo. 25s.

**Hayward. — Biographical and** Critical Essays, reprinted from Reviews, with Additions and Corrections. By A. HAYWARD, Esq., Q.C. 2 vols. 8vo. 24s.

**The Heirs of Cheveleigh: A** Novel. By GERVAISE ABBOTT. 3 vols. post 8vo. 31s. 6d.

**Sir John Herschel's Outlines of** Astronomy. Fifth Edition, revised and corrected to the existing state of astronomical knowledge; with Plates and Woodcuts. 8vo. 18s.

**Sir John Herschel's Essays** from the *Edinburgh* and *Quarterly Reviews*, with Addresses and other Pieces. 8vo. 18s.

**Hinchliff. — Summer Months** among the Alps: With the Ascent of Monte Rosa. By THOS. W. HINCHLIFF, Barrister-at-Law. Post 8vo. 10s. 6d.

**Hints on Etiquette and the** Usages of Society: With a Glance at Bad Habits. New Edition, revised (with Additions) by a Lady of Rank. Fcp. 8vo. 2s. 6d.

**Holland.—Medical Notes and** Reflections. By Sir HENRY HOLLAND, M.D., F.R.S., &c., Physician in Ordinary to the Queen and Prince-Consort. Third Edition. 8vo. 18s.

**Holland.—Chapters on Mental** Physiology. By Sir HENRY HOLLAND, Bart., F.R.S., &c. Founded chiefly on Chapters contained in *Medical Notes and Reflections* by the same Author. Second Edition. Post 8vo. 8s. 6d.

**Hooker.—Kew Gardens; or, a** Popular Guide to the Royal Botanic Gardens of Kew. By Sir WILLIAM JACKSON HOOKER, K.H., &c., Director. With many Woodcuts. 16mo. 6d.

**Hooker's Museum of Economic** Botany; or, Popular Guide to the Useful and Remarkable Vegetable Products of the Museum in the Royal Gardens of Kew. 16mo. 1s.

**Hooker and Arnott's British** Flora; comprising the Phænogamous or Flowering Plants, and the Ferns. Seventh Edition, with Additions and Corrections; and numerous Figures illustrative of the Umbelliferous Plants, the Composite Plants, the Grasses, and the Ferns. 12mo. with 12 Plates, 14s.; with the Plates coloured, 21s.

**Horne's Introduction to the** Critical Study and Knowledge of the Holy Scriptures. *Tenth Edition*, revised, corrected, and brought down to the present time. Edited by the Rev. T. HARTWELL HORNE, B.D. (the Author); the Rev. SAMUEL DAVIDSON, D.D. of the University of Halle, and LL.D.; and S. PRIDEAUX TREGELLES, LL.D. With 4 Maps and 22 Vignettes and Facsimiles. 4 vols. 8vo. £3. 13s. 6d.

**Horne.—A Compendious Intro**duction to the Study of the Bible. By the Rev. T. HARTWELL HORNE, B.D. New Edition, with Maps, &c. 12mo. 9s.

**Hoskyns.—Talpa; or, the Chro**nicles of a Clay Farm: An Agricultural Fragment. By CHANDOS WREN HOSKYNS, Esq. Fourth Edition. With 24 Woodcuts from Designs by GEORGE CRUIKSHANK. 16mo. 5s. 6d.

**How to Nurse Sick Children:** Intended especially as a Help to the Nurses in the Hospital for Sick Children; but containing Directions of service to all who have the charge of the Young. Fcp. 8vo. 1s. 6d.

**Howitt (A. M.)—An Art-Student in Munich.** By ANNA MARY HOWITT. 2 vols. post 8vo. 14s.

**Howitt.—The Children's Year.** By MARY HOWITT. With Four Illustrations. Square 16mo. 5s.

**Howitt. — Tallangetta, the** Squatter's Home: A Story of Australian Life. By WILLIAM HOWITT. 2 vols. post 8vo. 18s.

**Howitt. — Land, Labour, and** Gold; or, Two Years in Victoria: With Visit to Sydney and Van Diemen's Land. By WILLIAM HOWITT. Second Edition. 2 vols. crown 8vo. 10s.

**W. Howitt's Visits to Remarkable** Places: Old Halls, Battle-Fields, and Scenes illustrative of Striking Passages in English History and Poetry. With about 80 Wood Engravings. *New Edition.* 2 vols. square crown 8vo. 25s.

**William Howitt's Boy's Country** Book: Being the Real Life of a Country Boy, written by himself; exhibiting all the Amusements, Pleasures, and Pursuits of Children in the Country. With 40 Woodcuts. Fcp. 8vo. 6s.

**William Howitt's Rural Life of** England. With Woodcuts by Bewick and Williams. Medium 8vo. 21s.

**Huc. — Christianity in China,** Tartary, and Thibet. By M. l'Abbé HUC, formerly Missionary Apostolic in China. VOLS. I. and II. 8vo. 21s.; and VOL. III 10s. 6d.

**Huc. — The Chinese Empire:** A Sequel to Huc and Gabet's *Journey through Tartary and Thibet.* By the Abbé HUC, formerly Missionary Apostolic in China. *Second Edition;* with Map. 2 vols. 8vo. 24s.

**Hudson and Kennedy's Ascent** of Mont Blanc by a New Route and Without Guides. *Second Edition,* with Plate and Map. Post 8vo. 5s. 6d.

**Hudson's Plain Directions for** Making Wills in conformity with the Law: With a clear Exposition of the Law relating to the distribution of Personal Estate in the case of Intestacy, two Forms of Wills, and much useful information. Fcp. 8vo. 2s. 6d.

**Hudson's Executor's Guide.** New and improved Edition; with the Statutes enacted, and the Judicial Decisions pronounced since the last Edition incorporated. Fcp. 8vo. 6s.

**Humboldt's Cosmos. Translated,** with the Author's authority, by Mrs. SABINE. VOLS. I. and II. 16mo. Half-a-Crown each, sewed; 3s. 6d. each, cloth; or in post 8vo. 12s. each, cloth. VOL. III. post 8vo. 12s. 6d. cloth: or in 16mo. Part I. 2s. 6d. sewed, 3s. 6d. cloth; and Part II. 3s. sewed, 4s. cloth. VOL. IV. PART I. post 8vo. 15s. cloth; 16mo. 7s. 6d. cloth.

**Humboldt's Aspects of Nature.** Translated, with the Author's authority, by Mrs. SABINE. 16mo. price 6s.: or in 2 vols. 3s. 6d. each, cloth; 2s. 6d. each, sewed.

**Humphreys.— Parables of Our** Lord, illuminated and ornamented in the style of the Missals of the Renaissance by H. N. HUMPHREYS. Square fcp. 8vo. 21s. in massive carved covers; or 30s. bound in morocco, by Hayday.

**Hunt.—Researches on Light in** its Chemical Relations; embracing a Consideration of all the Photographic Processes. By ROBERT HUNT, F.R.S. Second Edition, with Plate and Woodcuts. 8vo. 10s. 6d.

**Hutchinson. — Impressions of** Western Africa: With a Report on the Peculiarities of Trade up the Rivers in the Bight of Biafra. By J. T. HUTCHINSON, Esq., British Consul for the Bight of Biafra and the Island of Fernando Po. Post 8vo. 8s. 6d.

**Idle.—Hints on Shooting, Fish**ing, &c., both on Sea and Land, and in the Fresh-Water Lochs of Scotland: Being the Experiences of C. IDLE, Esq. Fcp. 8vo. 5s.

**Mrs. Jameson's Legends of the** Saints and Martyrs, as represented in Christian Art: Forming the FIRST SERIES of *Sacred and Legendary Art.* Third Edition; with 17 Etchings and upwards of 180 Woodcuts. 2 vols. square crown 8vo. 31s. 6d.

**Mrs. Jameson's Legends of the** Monastic Orders, as represented in Christian Art. Forming the SECOND SERIES of *Sacred and Legendary Art.* Second Edition, enlarged; with 11 Etchings by the Author and 88 Woodcuts. Square crown 8vo. 28s.

**Mrs. Jameson's Legends of the** Madonna, as represented in Christian Art: Forming the THIRD SERIES of *Sacred and Legendary Art.* Second Edition, corrected and enlarged; with 27 Etchings and 165 Wood Engravings. Square crown 8vo. 28s.

**Mrs. Jameson's Commonplace-**Book of Thoughts, Memories, and Fancies, Original and Selected. *Second Edition,* revised and corrected; with Etchings and Woodcuts. Crown 8vo. price 18s.

**Mrs. Jameson's Two Lectures on** the Employment of Women: —

1. SISTERS *of* CHARITY, Catholic and Protestant, Abroad and at Home. *Second Edition,* with new Preface. Fcp. 8vo. 4*s.*
2. *The* COMMUNION *of* LABOUR: A Second Lecture on the Social Employments of Women. Fcp. 8vo. 3*s.*

**Jaquemet's Compendium of** Chronology: Containing the most important Dates of General History, Political, Ecclesiastical, and Literary, from the Creation of the World to the end of the Year 1854. Post 8vo. 7s. 6d.

**Jaquemet's Chronology for** Schools: Containing the most important Dates of General History, Political, Ecclesiastical, and Literary, from the Creation of the World to the end of the Year 1857. Fcp. 8vo. 3s. 6d.

**Lord Jeffrey's Contributions to** The Edinburgh Review. A New Edition, complete in One Volume, with Portrait and Vignette. Square crown 8vo. 21s. cloth; or 30s. calf.—Or in 3 vols. 8vo. price 42s.

**Bishop Jeremy Taylor's Entire** Works: With Life by Bishop HEBER. Revised and corrected by the Rev. CHARLES PAGE EDEN, Fellow of Oriel College, Oxford. Now complete in 10 vols. 8vo. 10s. 6d. each.

**Kemble. — The Saxons in Eng**land: A History of the English Commonwealth till the Conquest. By J. M. KEMBLE, M.A. 2 vols. 8vo. 28s.

**Keith Johnston's Dictionary of** Geography, Descriptive, Physical, Statistical, and Historical: Forming a complete General Gazetteer of the World. *Second Edition,* thoroughly revised. In 1 vol. of 1,360 pages, comprising about 50,000 Names of Places, 8vo. 36s. cloth; or half-bound in russia, 41s.

**Kesteven. — A Manual of the** Domestic Practice of Medicine. By W. B. KESTEVEN, F.R.C.S.E., &c. Square post 8vo. 7s. 6d.

**Kirby and Spence's Introduction** to Entomology; or, Elements of the Natural History of Insects: Comprising an Account of Noxious and Useful Insects, of their Metamorphoses, Food, Stratagems, Habitations, Societies, Motions, Noises, Hybernation, Instinct, &c. *Seventh Edition,* with an Appendix relative to the Origin and Progress of the work. Crown 8vo. 5s.

**Lardner's Cabinet Cyclopædia of** History, Biography, Literature, the Arts and Sciences, Natural History, and Manufactures. A Series of Original Works by EMINENT WRITERS. Complete in 132 vols. fcp. 8vo. with Vignette Titles, price £19. 19s. cloth lettered.

The Works *separately,* in single Volumes or Sets, price 3s. 6d. each Volume, cloth lettered.

**Mrs. R. Lee's Elements of Na**tural History; or, First Principles of Zoology: Comprising the Principles of Classification, interspersed with amusing and instructive Accounts of the most remarkable Animals. New Edition; Woodcuts. Fcp. 8vo. 7s. 6d.

**The Letters of a Betrothed.** Fcp. 8vo. price 5s. cloth.

**Letters to my Unknown Friends.** By a LADY, Author of *Letters on Happiness. Fourth Edition.* Fcp. 8vo. 5s.

**Letters on Happiness, addressed** to a Friend. By the Author of *Letters to my Unknown Friends.* Fcp. 8vo. 6s.

**L.E.L. — The Poetical Works of** Letitia Elizabeth Landon; comprising the *Improvisatrice,* the *Venetian Bracelet,* the *Golden Violet,* the *Troubadour,* and Poetical Remains. 2 vols. 16mo. 10s. cloth; morocco, 21s.

**Dr. John Lindley's Theory and** Practice of Horticulture; or, an Attempt to explain the principal Operations of Gardening upon Physiological Grounds: Being the Second Edition of the *Theory of Horticulture*, much enlarged; with 98 Woodcuts. 8vo. 21s.

**Dr. John Lindley's Introduction** to Botany. New Edition, with corrections and copious Additions. 2 vols. 8vo. with Plates and Woodcuts, 24s.

**Linwood. — Anthologia Oxoniensis**, sive Florilegium e Lusibus poeticis diversorum Oxoniensium Græcis et Latinis decerptum. Curante GULIELMO LINWOOD, M.A. 8vo. 14s.

**Lorimer's Letters to a Young** Master Mariner on some Subjects connected with his Calling. Fcp. 8vo. price 5s. 6d.

**Loudon's Encyclopædia of Gardening**: Comprising the Theory and Practice of Horticulture, Floriculture, Aboriculture, and Landscape-Gardening. With 1,000 Woodcuts. 8vo. 50s.

**Loudon's Encyclopædia of Trees** and Shrubs, or *Aboretum et Fructicetum Britannicum* abridged: Containing the Hardy Trees and Shrubs of Great Britain, Native and Foreign, Scientifically and Popularly Described. With about 2,000 Woodcuts. 8vo. 50s.

**Loudon's Encyclopædia of Agriculture**: Comprising the Theory and Practice of the Valuation, Transfer, Laying-out, Improvement, and Management of Landed Property, and of the Cultivation and Economy of the Animal and Vegetable Productions of Agriculture. With 1,100 Woodcuts. 8vo. 31s. 6d.

**Loudon's Encyclopædia of Plants:** Comprising the Specific Character, Description, Culture, History, Application in the Arts, and every other desirable Particular respecting all the Plants found in Great Britain. With upwards of 12,000 Woodcuts. 8vo. price £3. 13s. 6d.

**Loudon's Encyclopædia of Cottage**, Farm, and Villa Architecture and Furniture. New Edition, edited by Mrs. LOUDON; with more than 2,000 Woodcuts. 8vo. 63s.

**Loudon's Hortus Britannicus**; or, Catalogue of all the Plants found in Great Britain. New Edition, corrected by Mrs. LOUDON. 8vo. 31s. 6d.

**Mrs. Loudon's Lady's Country** Companion; or, How to Enjoy a Country Life Rationally. Fourth Edition. Fcp. 8vo. 5s.

**Mrs. Loudon's Amateur Gardener's** Calendar, or Monthly Guide to what should be avoided and done in a Garden. Second Edition, revised. Crown 8vo. with Woodcuts, 7s. 6d.

**Low's Elements of Practical** Agriculture; comprehending the Cultivation of Plants, the Husbandry of the Domestic Animals, and the Economy of the Farm. New Edition; with 200 Woodcuts. 8vo. 21s.

**Macaulay. — Speeches of the** Right Hon. Lord MACAULAY. Corrected by HIMSELF. 8vo. 12s.

**Macaulay. — The History of** England from the Accession of James II. By the Right Hon. Lord MACAULAY. New Edition. Vols. I. and II. 8vo. 32s.; Vols. III. and IV. 36s.

**Lord Macaulay's History of England** from the Accession of James II. New Edition of the first Four Volumes of the Octavo Edition, revised and corrected. 7 vols. post 8vo. 6s. each.

**Lord Macaulay's Critical and** Historical Essays contributed to The Edinburgh Review. Four Editions:—

1. A LIBRARY EDITION (the *Eighth*), in 3 vols. 8vo. price 36s.
2. Complete in ONE VOLUME, with Portrait and Vignette. Square crown 8vo. price 21s. cloth; or 30s. calf.
3. Another NEW EDITION, in 3 vols. fcp. 8vo. price 21s. cloth.
4. The PEOPLE'S EDITION, in 2 vols. crown 8vo. price 8s. cloth.

**Macaulay. — Lays of Ancient** Rome, with *Ivry* and the *Armada*. By the Right Hon. Lord MACAULAY. New Edition. 16mo. price 4s. 6d. cloth; or 10s. 6d. bound in morocco.

**Lord Macaulay's Lays of Ancient** Rome. With numerous Illustrations, Original and from the Antique, drawn on Wood by George Scharf, jun. Fcp. 4to. 21s. boards; or 42s. bound in morocco.

**Mac Donald.—Poems. By George** MAC DONALD, Author of *Within and Without*. Fcp. 8vo. 7s.

**Mac Donald. — Within and** Without: A Dramatic Poem. By George Mac Donald. Fcp. 8vo. 4s. 6d.

**Mac Dougall. — The Theory of** War illustrated by numerous Examples from History. By Lieutenant-Colonel Mac Dougall, Commandant of the Staff College. *Second Edition*, revised. Post 8vo. with Plans, 10s. 6d.

**Mac Dougall. — The Campaigns** of Hannibal, arranged and critically considered, expressly for the use of Students of Military History. By Lieut.-Col. P. L. Mac Dougall, Commandant of the Staff College. Post 8vo. 7s. 6d.

**M'Dougall. — The Eventful** Voyage of *H.M. Discovery Ship* Resolute *to the Arctic Regions in search of Sir John Franklin and the Missing Crews of H.M. Discovery Ships* Erebus *and* Terror, 1852, 1853, 1854. By George F. M'Dougall, Master. With a coloured Chart, Illustrations in Lithography, and Woodcuts. 8vo. 21s.

**Sir James Mackintosh's Miscel**laneous Works: Including his Contributions to The Edinburgh Review. Complete in One Volume; with Portrait and Vignette. Square crown 8vo. 21s. cloth; or 30s. bound in calf: or in 3 vols. fcp. 8vo. 21s.

**Sir James Mackintosh's History** of England from the Earliest Times to the final Establishment of the Reformation. 2 vols. 8vo. 21s.

**Macleod.—The Elements of Po**litical Economy. By Henry Dunning Macleod, Barrister-at-Law. 8vo. 16s.

**Macleod. — The Theory and** Practice of Banking: With the Elementary Principles of Currency, Prices, Credit, and Exchanges. By Henry Dunning Macleod, Barrister-at-Law. 2 vols. royal 8vo. 30s.

**M'Culloch's Dictionary, Prac**tical, Theoretical, and Historical, of Commerce, and Commercial Navigation. Illustrated with Maps and Plans. New Edition, corrected; with Supplement. 8vo. 50s. cloth; half-russia, 55s.

**M'Culloch's Dictionary, Geo**graphical, Statistical, and Historical, of the various Countries, Places, and principal Natural Objects in the World. Illustrated with Six large Maps. New Edition, revised. 2 vols. 8vo. 63s.

**Maguire. — Rome; its Ruler** and its Institutions. By John Francis Maguire, M.P. With a Portrait of Pope Pius IX. Post 8vo. 10s. 6d.

**Mrs. Marcet's Conversations on** Natural Philosophy, in which the Elements of that Science are familiarly explained. Thirteenth Edition, enlarged and corrected; with 34 Plates. Fcp. 8vo. price 10s. 6d.

**Mrs. Marcet's Conversations on** Chemistry, in which the Elements of that Science are familiarly explained and illustrated by Experiments. New Edition, improved. 2 vols. fcp. 8vo. 14s.

**Martineau. — Studies of Chris**tianity: A Series of Original Papers, now first collected, or New. By James Martineau. Crown 8vo. 7s. 6d.

**Martineau. — Endeavours after** the Christian Life: Discourses. By James Martineau. 2 vols. post 8vo. price 7s. 6d. each.

**Martineau. — Hymns for the** Christian Church and Home. Collected and edited by James Martineau. *Eleventh Edition*, 12mo. 3s. 6d. cloth, or 5s. calf; *Fifth Edition*, 32mo. 1s. 4d. cloth, or 1s. 8d. roan.

**Martineau.—Miscellanies: Com**prising Essays chiefly religious and controversial. By James Martineau. Crown 8vo. 9s.

**Maunder's Scientific and Lite**rary Treasury: A new and popular Encyclopædia of Science and the Belles-Lettres; including all Branches of Science, and every subject connected with Literature and Art. Fcp. 8vo. 10s.

**Maunder's Biographical Trea**sury; consisting of Memoirs, Sketches, and brief Notices of above 12,000 Eminent Persons of All Ages and Nations, from the Earliest Period of History: Forming a complete Dictionary of Universal Biography. Fcp. 8vo. 10s.

**Maunder's Treasury of Know**ledge, and Library of Reference; comprising an English Dictionary and Grammar, a Universal Gazetteer, a Classical Dictionary, a Chronology, a Law Dictionary, a Synopsis of the Peerage, numerous useful Tables, &c. Fcp. 8vo. 10s.

**Maunder's Treasury of Natural** History; or, a Popular Dictionary of Animated Nature: In which the Zoological Characteristics that distinguish the different Classes, Genera, and Species, are combined with a variety of interesting Information illustrative of the Habits, Instincts, and General Economy of the Animal Kingdom. With 900 Woodcuts. Fcp. 10s.

**Maunder's Historical Treasury;** comprising a General Introductory Outline of Universal History, Ancient and Modern, and a Series of Separate Histories of every principal Nation that exists; their Rise, Progress, and Present Condition, the Moral and Social Character of their respective Inhabitants, their Religion, Manners, and Customs, &c. Fcp. 8vo. 10s.

**Maunder's Treasury of Geography,** Physical, Historical, Descriptive, and Political; containing a succinct Account of Every Country in the World: Preceded by an Introductory Outline of the History of Geography; a Familiar Inquiry into the Varieties of Race and Language exhibited by different Nations; and a View of the Relations of Geography to Astronomy and the Physical Sciences. Completed by WILLIAM HUGHES, F.R.G.S. With 7 Maps and 16 Steel Plates. Fcp. 8vo. 10s.

**Merivale. — A History of the** Romans under the Empire. By the Rev. CHARLES MERIVALE, B.D., late Fellow of St. John's College, Cambridge. 8vo. with Maps.

VOLS. I and II. comprising the History to the Fall of *Julius Cæsar*. Second Edition, 28s.

VOL. III. to the Establishment of the Monarchy by *Augustus*. Second Edition......14s.

VOLS. IV. and V. from *Augustus* to *Claudius*, B.C. 27 to A.D. 54 ........................32s.

VOL. VI. from the Reign of Nero, A.D. 54, to the Fall of Jerusalem, A.D. 70.............16s.

**Merivale. — The Fall of the** Roman Republic: A Short History of Last Century of the Commonwealth. By the Rev. C. MERIVALE, B. D., late Fellow of St. John's College, Cambridge. New Edition. 12mo. 7s. 6d.

**Merivale (Miss). — Christian** Records: A Short History of Apostolic Age. By L. A. MERIVALE. Fcp. 8vo. price 7s. 6d.

**Miles.—The Horse's Foot and** How to Keep it Sound. *Eighth Edition;* with an Appendix on Shoeing in general, and Hunters in particular. 12 Plates and 12 Woodcuts. By W. MILES, Esq. Imperial 8vo. 12s. 6d.

**Miles's Plain Treatise on Horse-**Shoeing. With Plates and Woodcuts. Second Edition. Post 8vo. 2s.

**Milner's History of the Church** of Christ. With Additions by the late Rev. ISAAC MILNER, D.D., F.R.S. A New Edition, revised, with additional Notes by the Rev. T. GRANTHAM, B.D. 4 vols. 8vo. 52s.

**James Montgomery's Poetical** Works: Collective Edition; with the Author's Autobiographical Prefaces, complete in One Volume; with Portrait and Vignette. Square crown 8vo. 10s. 6d. cloth; morocco, 21s.—Or, in 4 vols. fcp. 8vo. with Plates, 14s.

**Moore.—The Power of the Soul** over the Body, considered in relation to Health and Morals. By GEORGE MOORE, M.D. Fcp. 8vo. 6s.

**Moore.—Man and his Motives.** By GEORGE MOORE, M.D. Fcp. 8vo. 6s.

**Moore.—The Use of the Body in** relation to the Mind. By G. MOORE, M.D. Fcp. 8vo. 6s.

**Moore.—Memoirs, Journal, and** Correspondence of Thomas Moore. Edited by the Right Hon. LORD JOHN RUSSELL, M.P. With Portraits and Vignettes. 8 vols. post 8vo. £4. 4s.

**Thomas Moore's Poetical Works:** Comprising the Author's Recent Introductions and Notes. The *Traveller's Edition*, crown 8vo. with Portrait, 12s. 6d. cloth; morocco by Hayday, 21s. —Also the *Library Edition*, with Portrait and Vignette, medium 8vo. 21s. cloth; morocco by Hayday, 42s.—And the *First collected Edition*, in 10 vols. fcp. 8vo. with Portrait and 19 Plates, 35s.

**Moore. — Poetry and Pictures** from Thomas Moore: Being Selections of the most popular and admired of Moore's Poems, copiously illustrated with highly-finished Wood Engravings from original Designs by eminent Artists. Fcp. 4to. price 21s. cloth; or 42s. bound in morocco by Hayday.

**Moore's Songs, Ballads, and** Sacred Songs. New Edition, printed in Ruby Type; with the Notes, and a Vignette from a Design by T. Creswick, R.A. 32mo. 2s. 6d. — An Edition in 16mo. with Vignette by R. Doyle, 5s.; or 12s. 6d. morocco by Hayday.

**Moore's Sacred Songs, the Sym-**phonies and Accompaniments, arranged for One or more Voices, printed with the Words. Imperial 8vo. [*Nearly ready.*

**Moore's Lalla Rookh: An Ori-**ental Romance. With 13 highly-finished Steel Plates from Original Designs by Corbould, Meadows, and Stephanoff, engraved under the superintendence of the late Charles Heath. New Edition. Square crown 8vo. 15s. cloth; morocco, 28s.

**Moore's Lalla Rookh. New** Edition, printed in Ruby Type; with the Preface and Notes from the collective edition of *Moore's Poetical Works*, and a Frontispiece from a Design by Kenny Meadows. 32mo. 2s. 6d.—An Edition in 16mo. with Vignette, 5s.; or 12s. 6d. morocco by Hayday.

**Moore's Lalla Rookh. A New** Edition, with numerous Illustrations from original Designs by JOHN TENNIEL, engraved on Wood by the Brothers DALZIEL. Fcp. 4to. [*In preparation.*

**Moore's Irish Melodies. A New** Edition, with 13 highly-finished Steel Plates, from Original Designs by eminent Artists. Square crown 8vo. 21s. cloth; or 31s. 6d. bound in morocco.

**Moore's Irish Melodies, printed** in Ruby Type; with the Preface and Notes from the collective edition of *Moore's Poetical Works*, the Advertisements originally prefixed, and a Portrait of the Author. 32mo. 2s. 6d. An Edition in 16mo. with Vignette, 5s.; or 12s. 6d. morocco by Hayday.

**Moore's Irish Melodies. Illus-**trated by D. Maclise, R.A. New Edition; with 161 Designs, and the whole of the Letterpress engraved on Steel, by F. P. Becker. Super-royal 8vo. 31s. 6d. boards; or £2. 12s. 6d. morocco.

**Moore's Irish Melodies, the** Music, namely, the Symphonies and Accompaniments by Sir JOHN STEVENSON and Sir HENRY BISHOP, printed with the Words. Imperial 8vo. 31s. 6d. cloth; or 42s. half-bound in morocco.

**The Harmonised Airs from** Moore's Irish Melodies, as originally arranged for Two, Three, or Four Voices, printed with the Words. Imp. 8vo. 15s. cloth; or 25s. half-bound in morocco.

**Moore's National Melodies, with** Music. National Airs and other Songs, now first collected. By THOMAS MOORE. The Music, for Voice and Pianoforte, printed with the Words. Imp. 8vo. 31s. 6d. cloth; or 42s. half-bound in morocco.

**Moore's Epicurean. New** Edition, with the Notes from the Collective Edition of *Moore's Poetical Works*; and a Vignette engraved on Wood from an original Design by D. MACLISE, R.A. 16mo. 5s. cloth; or 12s. 6d. morocco by Hayday.

**Morell.—Elements of Psycho-**logy: PART I., containing the Analysis of the Intellectual Powers. By J. D. MORELL, M.A., One of Her Majesty's Inspectors of Schools. Post 8vo. 7s. 6d.

**Morning Clouds. Second and** cheaper Edition, revised throughout, and printed in a more convenient form. Fcp. 8vo. 5s.

**Morton.—The Resources of Es-**tates: A Treatise on the Agricultural Improvement and General Management of Landed Property. By JOHN LOCKHART MORTON, Civil and Agricultural Engineer; Author of Thirteen Highland and Agricultural Prize Essays. With 25 Lithographic Illustrations. Royal 8vo. 31s. 6d.

**Moseley's Mechanical Principles** of Engineering and Architecture. Second Edition, enlarged; with numerous Woodcuts. 8vo. 24s.

**Memoirs and Letters of the late** Colonel ARMINE MOUNTAIN, Aide-de-Camp to the Queen, and Adjutant-General of Her Majesty's Forces in India. Edited by Mrs. MOUNTAIN. Second Edition, Portrait. Fcp. 8vo. 6s.

**Mure.—A Critical History of the** Language and Literature of Ancient Greece. By WILLIAM MURE, of Caldwell. VOLS. I. to III. 8vo. price 36s.; VOL. IV. 15s.; and VOL. V. 18s.

**Murray's Encyclopædia of Geo-**graphy, comprising a complete Description of the Earth: Exhibiting its Relation to the Heavenly Bodies, its Physical Structure, the Natural History of each Country, and the Industry, Commerce, Political Institutions, and Civil, and Social State of All Nations. Second Edition; with 82 Maps, and upwards of 1,000 other Woodcuts. 8vo. 60s.

**Murray.—French Finance and** Financiers under Louis the Fifteenth. By James Murray. 8vo. 10s. 6d.

**Neale.—The Closing Scene; or,** Christianity and Infidelity contrasted in the Last Hours of Remarkable Persons. By the Rev. Erskine Neale, M.A. 2 vols. fcp. 8vo. 6s. each.

**Normanby (Marquis of).—A** Year of Revolution. From a Journal kept in Paris in the Year 1848. By the Marquis of Normanby, K.G. 2 vols. 8vo. 24s.

**Ogilvie.—The Master-Builder's** Plan; or, the Principles of Organic Architecture as indicated in the Typical Forms of Animals. By George Ogilvie, M.D. Post 8vo. with 72 Woodcuts, price 6s. 6d.

**Oldacre.—The Last of the Old** Squires. A Sketch. By Cedric Oldacre, Esq., of Sax-Normanbury. Crown 8vo. 9s. 6d.

**Osborn.—Quedah; or, Stray** Leaves from a Journal in Malayan Waters. By Captain Sherard Osborn, R.N., C.B. With a coloured Chart and tinted Illustrations. Post 8vo. 10s. 6d.

**Osborn.—The Discovery of the** North-West Passage by H.M.S. *Investigator*, Captain R. M'Clure, 1850-1854. Edited by Captain Sherard Osborn, C.B. Second Edition, revised; with Portrait, Chart, and Illustrations. 8vo. price 15s.

**Professor Owen's Lectures on** the Comparative Anatomy and Physiology of the Invertebrate Animals, delivered at the Royal College of Surgeons. Second Edition, with 235 Woodcuts. 8vo. 21s.

**Professor Owen's Lectures on** the Comparative Anatomy and Physiology of the Vertebrate Animals, delivered at the Royal College of Surgeons in 1844 and 1846. Vol. I. 8vo. 14s.

**Memoirs of Admiral Parry, the** Arctic Navigator. By his Son, the Rev. E. Parry, M.A., Domestic Chaplain to the Bishop of London. Fourth Edition; with a Portrait and coloured Chart of the North-West Passage. Fcp. 8vo. 5s.

**Pattison.—The Earth and the** Word; or, Geology for Bible Students. By S. R. Pattison, F.G.S. Fcp. 8vo. with coloured Map, 3s. 6d.

**Dr. Pereira's Elements of Mate**ria Medica and Therapeutics. *Third Edition*, enlarged and improved from the Author's Materials by A. S. Taylor, M.D., and G. O. Rees, M.D. Vol. I. 8vo. 28s.; Vol. II. Part I. 21s.; Vol. II. Part II. 26s.

**Dr. Pereira's Lectures on Polar**ised Light, together with a Lecture on the Microscope. 2d Edition, enlarged from the Author's Materials by Rev. B. Powell, M.A. Fcp. 8vo. Woodcuts, price 7s.

**Perry.—The Franks, from their** First Appearance in History to the Death of King Pepin. By Walter C. Perry, Barrister-at-Law. 8vo. 12s. 6d.

**Peschel's Elements of Physics.** Translated from the German, with Notes, by E. West. With Diagrams and Woodcuts. 3 vols. fcp. 8vo. 21s.

**Phillips's Elementary Introduc**tion to Mineralogy. A New Edition, with extensive Alterations and Additions, by H. J. Brooke, F.R.S., F.G.S.; and W. H. Miller, M.A., F.G.S. With numerous Woodcuts. Post 8vo. 18s.

**Phillips.—A Guide to Geology.** By John Phillips, M.A., F.R.S., F.G.S., &c. Fourth Edition, corrected; with 4 Plates. Fcp. 8vo. 5s.

**Phillips.—Figures and Descrip**tions of the Palæozoic Fossils of Cornwall, Devon, and West Somerset: observed in the course of the Ordnance Geological Survey of that District. By John Phillips, F.R.S., F.G.S., &c. 8vo. with 60 Plates, 9s.

**Piesse's Art of Perfumery, and** Methods of Obtaining the Odours of Plants; with Instructions for the Manufacture of Perfumes for the Handkerchief, Scented Powders, Odorous Vinegars, Dentifrices, Pomatums, Cosmétiques, Perfumed Soap, &c.; and an Appendix on the Colours of Flowers, Artificial Fruit Essences, &c. *Second Edition;* Woodcuts. Crown 8vo. 8s. 6d.

**Captain Portlock's Report on the** Geology of the County of Londonderry, and of Parts of Tyrone and Fermanagh, examined and described under the Authority of the Master-General and Board of Ordnance. 8vo. with 48 Plates, 24s.

**Powell.—Essays on the Spirit of** the Inductive Philosophy, the Unity of Worlds, and the Philosophy of Creation. By the Rev. BADEN POWELL, M.A., &c. Crown 8vo. Woodcuts, 12s. 6d.

**Powell.—Christianity without** Judaism: A Second Series of Essays on the Unity of Worlds and of Nature. By the Rev. BADEN POWELL, M.A., &c. Crown 8vo. 7s. 6d.

**Pycroft.—The Collegian's Guide;** or, Recollections of College Days: Setting forth the Advantages and Temptations of a University Education. By the Rev. J. PYCROFT, B.A. *Second Edition.* Fcp. 8vo. 6s.

**Pycroft's Course of English** Reading; or, How and What to Read: Adapted to every taste and capacity. With Literary Anecdotes. Fcp. 8vo. 5s.

**Pycroft's Cricket-Field; or, the** Science and History of the Game of Cricket. Second Edition; Plates and Woodcuts. Fcp. 8vo. 5s.

**Quatrefages (A. De).—Rambles** of a Naturalist on the Coasts of France, Spain, and Sicily. By A. DE QUATREFAGES, Memb. Inst. Translated by E. C. OTTE'. 2 vols. post 8vo. 15s.

**Raikes (C.)—Notes on the Re**volt in the North-Western Provinces of India. By CHARLES RAIKES, Judge of the Sudder Court, and late Civil Commissioner with Sir Colin Campbell. 8vo. 7s. 6d.

**Raikes (T.)—Portion of the Jour**nal kept by THOMAS RAIKES, Esq., from 1831 to 1847: Comprising Reminiscences of Social and Political Life in London and Paris during that period. 2 vols. crown 8vo. price 12s.

**Rarey.—A Complete Treatise on** the Science of Handling, Educating, and Taming all Horses; with a full and detailed Narrative of his Experience and Practice. By JOHN S. RAREY, of Ohio, *U. S.* In 1 vol. with numerous Illustrations. [*Just ready.*

**Dr. Reece's Medical Guide: Com**prising a complete Modern Dispensatory, and a Practical Treatise on the distinguishing Symptoms, Causes, Prevention, Cure, and Palliation of the Diseases incident to the Human Frame. Seventeenth Edition, corrected and enlarged by Dr. H. REECE. 8vo. 12s.

**Reade.—The Poetical Works of** John Edmund Reade. New Edition, revised and corrected; with Additional Poems. 4 vols. fcp. 8vo. 20s.

**Rees.—Personal Narrative of** the Siege of Lucknow, from its commencement to its Relief by Sir Colin Campbell. By L. E. REES, one of the surviving Defenders. Third Edition. Post 8vo. price 9s. 6d.

**Rich's Illustrated Companion to** the Latin Dictionary and Greek Lexicon; Forming a Glossary of all the Words representing Visible Objects connected with the Arts, Manufactures, and Every-Day Life of the Ancients. With about 2,000 Woodcuts from the Antique. Post 8vo. 21s.

**Richardson.—Fourteen Years'** Experience of Cold Water: Its Uses and Abuses. By Captain M. RICHARDSON. Post 8vo. Woodcuts, 6s.

**Horsemanship; or, the Art of** Riding and Managing a Horse, adapted to the Guidance of Ladies and Gentlemen on the Road and in the Field: With Instructions for Breaking-in Colts and Young Horses. By Captain RICHARDSON, late of the 4th Light Dragoons. With 5 Plates. Square crown 8vo. 14s.

**Household Prayers for Four** Weeks: With additional Prayers for Special Occasions. To which is added a Course of Scripture Reading for Every Day in the Year. By the Rev. J. E. RIDDLE, M.A. Crown 8vo. 3s. 6d.

**Riddle's Complete Latin-English** and English-Latin Dictionary, for the use of Colleges and Schools. *New Edition*, revised and corrected. 8vo. 21s.

**Riddle's Diamond Latin-English** Dictionary. A Guide to the Meaning, Quality, and right Accentuation of Latin Classical Words. Royal 32mo. 4s.

**Riddle's Copious and Critical** Latin-English Lexicon, founded on the German-Latin Dictionaries of Dr. William Freund. Post 4to. 31s. 6d.

**Rivers's Rose-Amateur's Guide;** containing ample Descriptions of all the fine leading variety of Roses, regularly classed in their respective Families; their History and Mode of Culture. Sixth Edition. Fcp. 8vo. 3s. 6d.

**Dr. E. Robinson's Greek and** English Lexicon to the Greek Testament. A New Edition, revised and in great part re-written. 8vo. 18s.

**Mr. Henry Rogers's Essays** selected from Contributions to the *Edinburgh Review.* Second Edition, with Additions. 3 vols. fcp. 8vo. 21s.

**Dr. Roget's Thesaurus of English** Words and Phrases classified and arranged so as to facilitate the Expression of Ideas and assist in Literary Composition. Fifth Edition, revised and improved. Crown 8vo. 10s. 6d.

**Ronalds's Fly-Fisher's Entomology:** With coloured Representation of the Natural and Artificial Insects, and a few Observations and Instructions on Trout and Grayling Fishing. *Fifth Edition;* with 20 new-coloured Plates. 8vo. 14s.

**Rowton's Debater: A Series of** complete Debates, Outlines of Debates, and Questions for Discussion; with ample References to the best Sources of Information. Fcp. 8vo. 6s.

**Dr. C. W. Russell's Life of Cardinal** Mezzofanti: With an Introductory Memoir of eminent Linguists, Ancient and Modern. With Portrait and Facsimiles. 8vo. 12s.

**The Saints our Example. By** the Author of *Letters to my Unknown Friends,* &c. Fcp. 8vo. 7s.

**Scherzer.—Travels in the Free** States of Central America: Nicaragua, Honduras, and San Salvador. By Dr. CARL SCHERZER. 2 vols. post 8vo. 16s.

**SchimmelPenninck (Mrs.) —** Life of Mary Anne SchimmelPenninck, Author of *Select Memoirs of Port Royal,* and other Works. Edited by her relation, CHRISTIANA C. HANKIN. 2 vols. post 8vo. with Portrait, 15s.

**Dr. L. Schmitz's History of** Greece, from the Earliest Times to the Taking of Corinth by the Romans, B.C. 146, mainly based upon Bishop Thirlwall's History. *Fifth Edition,* with Nine new Supplementary Chapters on the Civilisation, Religion, Literature, and Arts of the Ancient Greeks, contributed by C. H. WATSON, M.A. Trin. Coll. Camb.; also a Map of Athens and 137 Woodcuts designed by G. Scharf, jun., F.S.A. 12mo. 7s. 6d.

**Scoffern (Dr.)—Projectile Weapons** of War and Explosive Compounds. By J. SCOFFERN, M.B. Lond., late Professor of Chemistry in the Aldersgate College of Medicine. *Third Edition.* Post 8vo. Woodcuts, 8s. 6d.

**Scrivenor's History of the Iron** Trade, from the Earliest Records to the Present Period. 8vo. 10s. 6d.

**Sir Edward Seaward's Narrative** of his Shipwreck, and consequent Discovery of certain Islands in the Caribbean Sea. 2 vols. post 8vo. 21s.

**The Sermon in the Mount.** Printed by C. Whittingham, uniformly with the *Thumb Bible.* 64mo. 1s. 6d.

**Sewell (Miss).—New Edition of** the Tales and Stories of the Author of *Amy Herbert,* in 9 vols. crown 8vo. price £1. 10s. cloth; or each work complete in one volume, separately as follows:—

| | |
|---|---|
| AMY HERBERT | 2s. 6d. |
| GERTRUDE | 2s. 6d. |
| The EARL'S DAUGHTER | 2s. 6d. |
| The EXPERIENCE of LIFE | 2s. 6d. |
| CLEVE HALL | 3s. 6d. |
| IVORS, or the Two COUSINS | 3s. 6d. |
| KATHARINE ASHTON | 3s. 6d. |
| MARGARET PERCIVAL | 5s. 0d. |
| LANETON PARSONAGE | 4s. 6d. |

*By the same Author, New Editions,*

**Ursula: A Tale of English** Country Life. 2 vols. fcp. 8vo. 12s.

**Readings for every Day in Lent:** Compiled from the Writings of Bishop JEREMY TAYLOR. Fcp. 8vo. 5s.

**Readings for a Month preparatory** to Confirmation: Compiled from the Works of Writers of the Early and of the English Church. Fcp. 8vo. 4s.

---

**Bowdler's Family Shakspeare:** In which nothing is *added* to the Original Text; but those words and expressions are *omitted* which cannot with propriety be read aloud. Illustrated with 36 Woodcut Vignettes. The *Library Edition,* in One Volume, medium 8vo. price 21s.; a *Pocket Edition,* in 6 vols. fcp. 8vo. price 5s. each.

**Sharp's New British Gazetteer,** or Topographical Dictionary of the British Islands and narrow Seas: Comprising concise Descriptions of about 60,000 Places, Seats, Natural Features, and Objects of Note, founded on the best authorities. 2 vols. 8vo. £2. 16s.

**Short Whist; its Rise, Progress,** and Laws: With Observations to make any one a Whist-Player. Containing also the Laws of Piquet, Cassino, Ecarté, Cribbage, Backgammon. By Major A. New Edition; with Precepts for Tyros, by Mrs. B. Fcp. 8vo. 3s.

**Sinclair.—The Journey of Life.** By CATHERINE SINCLAIR, Author of *The Business of Life.* Fcp. 8vo. 5s.

**Sir Roger De Coverley. From** the Spectator. With Notes and Illustrations, by W. HENRY WILLS; and 12 Wood Engravings from Designs by F. TAYLER. Crown 8vo. 10s. 6d.; or 21s. in morocco by Hayday.

**The Sketches: Three Tales. By** the Authors of *Amy Herbert, The Old Man's Home,* and *Hawkstone.* Fcp. 8vo. price 4s. 6d.

**Smee's Elements of Electro-**Metallurgy. Third Edition, revised; with Electrotypes and numerous Woodcuts. Post 8vo. 10s. 6d.

**Smith (G.)—History of Wes-**leyan Methodism. By GEORGE SMITH, F.A.S., Author of *Sacred Annals,* &c. VOL. I. *Wesley and his Times;* VOL. II. *The Middle Age of Methodism,* from 1791 to 1816. Crown 8vo. 10s. 6d. each.

**Smith (G. V.)—The Prophecies** relating to Nineveh and the Assyrians. Translated from the Hebrew, with Historical Introductions and Notes, exhibiting the principal Results of the recent Discoveries. By GEORGE VANCE SMITH, B. A. Post 8vo. 10s. 6d.

**Smith (J.)—The Voyage and** Shipwreck of St. Paul: With Dissertations on the Life and Writings of St. Luke, and the Ships and Navigation of the Ancients. By JAMES SMITH, F.R.S. With Charts, Views, and Woodcuts. Crown 8vo. 8s. 6d.

**A Memoir of the Rev. Sydney** Smith. By his Daughter, LADY HOLLAND. With a Selection from his Letters, edited by Mrs. AUSTIN. *New Edition.* 2 vols. 8vo. 28s.

**The Rev. Sydney Smith's Mis-**cellaneous Works: Including his Contributions to The Edinburgh Review. Three Editions:—

1. A LIBRARY EDITION (the *Fourth*), in 3 vols. 8vo. with Portrait, 36s.
2. Complete in ONE VOLUME, with Portrait and Vignette. Square crown, 8vo. 21s. cloth; or 30s. bound in calf.
3. Another NEW EDITION, in 3 vols. fcp. 8vo. 21s.

**The Rev. Sydney Smith's Ele-**mentary Sketches of Moral Philosophy, delivered at the Royal Institution in the Years 1804 to 1806. Fcp. 8vo. 7s.

**Snow.—Two Years' Cruise off** Tierra del Fuego, the Falkland Islands, Patagonia, and in the River Plate: A Narrative of Life in the Southern Seas. By W. PARKER SNOW, late Commander of the Mission Yacht *Allen Gardiner.* With Charts and Illustrations. 2 vols. post 8vo. 24s.

**Robert Southey's Complete Poet-**ical Works; containing all the Author's last Introductions and Notes. The *Library Edition,* complete in One Volume, with Portraits and Vignette. Medium 8vo. 21s. cloth; 42s. bound in morocco.—Also, the *First collected Edition,* in 10 vols. fcp. 8vo. with Portrait and 19 Vignettes, price 35s.

**The Life and Correspondence** of the late Robert Southey. Edited by his Son, the Rev. C. C. SOUTHEY, M.A. With Portraits, &c. 6 vols. post 8vo. price 63s.

**Southey's Doctor, complete in** One Volume. Edited by the Rev. J. W. WARTER, B.D. With Portrait, Vignette, Bust, and coloured Plate. Square crown 8vo. 21s.

**Southey's Life of Wesley; and** Rise and Progress of Methodism. Fourth Edition, edited by Rev. C. C. SOUTHEY, M.A. 2 vols. crown 8vo. 12s.

**Spencer.—Essays, Scientific, Po-**litical, and Speculative. By HERBERT SPENCER, Author of *Social Statics.* Reprinted chiefly from Quarterly Reviews. 8vo. 12s. cloth.

**Spencer.—The Principles of** Psychology. By HERBERT SPENCER, Author of *Social Statics.* 8vo. 16s.

**Stephen. — Lectures on the History of France.** By the Right Hon. Sir JAMES STEPHEN, K.C.B., LL.D. Third Edition. 2 vols. 8vo. 24s.

**Stephen. — Essays in Ecclesiastical Biography;** from The Edinburgh Review. By the Right Hon. Sir JAMES STEPHEN, K.C.B., LL.D. Third Edition. 2 vols. 8vo. 24s.

**Stonehenge.—The Dog in Health and Disease:** Comprising the various Modes of Breaking and using him for Hunting, Coursing, Shooting, &c.; and including the Points or Characteristics of Toy Dogs. By STONEHENGE. 8vo. with numerous Illustrations.

[*In the press.*

**Stonehenge.—The Greyhound:** Being a Treatise on the Art of Breeding, Rearing, and Training Greyhounds for Public Running; their Diseases and Treatment: Containing also Rules for the Management of Coursing Meetings, and for the Decision of Courses. By STONEHENGE. With Frontispiece and Woodcuts. Square crown 8vo. 21s.

**Stow's Training System, Moral** Training School, and Normal Seminary for preparing Schoolmasters and Governesses. Tenth Edition; Plates and Woodcuts. Post 8vo. 6s

**Strickland.—Lives of the Queens** of England. By AGNES STRICKLAND. Dedicated, by express permission, to Her Majesty. Embellished with Portraits of every Queen, engraved from the most authentic sources. Complete in 8 vols. post 8vo. 7s. 6d. each.

**Memoirs of the Life and Services** of Rear-Admiral Sir William Symonds, late Surveyor of the Navy. Edited by J. A. SHARP. 8vo. with Illustrations, price 21s.

**Taylor.—Loyola: and Jesuitism** in its Rudiments. By ISAAC TAYLOR. Post 8vo. Medallion, 10s. 6d.

**Taylor.— Wesley and Methodism.** By ISAAC TAYLOR. Post 8vo. Portrait, 10s. 6d.

**Thacker's Courser's Annual Remembrancer and Stud-Book:** Being an Alphabetical Return of the Running at all Public Coursing Clubs in England, Ireland, and Scotland, for the Season 1857-8; with the *Pedigrees* (as far as received) of the DOGS. By ROBERT ABRAM WELSH, Liverpool. 8vo. 21s.

*** Published annually in *October*.

**Bishop Thirlwall's History of** Greece. Library Edition; with Maps. 8 vols. 8vo. £3.—An Edition in 8 vols. fcp. 8vo. with Vignette Titles, 28s.

**Thomson's Seasons. Edited by** BOLTON CORNEY, Esq. Illustrated with 77 fine Wood Engravings from Designs by Members of the Etching Club. Square crown 8vo. 21s. cloth; or 36s. bound in morocco.

**Thomson (the Rev. Dr.) — An** Outline of the necessary Laws of Thought: A Treatise on Pure and Applied Logic. By WILLIAM THOMSON, D.D. New Edition. Fcp. 8vo. 7s. 6d.

**Thomson's Tables of Interest,** at Three, Four, Four-and-a-Half, and Five per Cent., from One Pound to Ten Thousand, and from 1 to 365 Days, in a regular progression of single Days; with Interest at all the above Rates, from One to Twelve Months, and from One to Ten Years. Also, numerous other Tables of Exchange, Time, and Discounts. New Edition. 12mo. 8s.

**The Thumb Bible; or, Verbum** Sempiternum. By J. TAYLOR. Being an Epitome of the Old and New Testaments in English Verse. Reprinted from the Edition of 1693. 64mo. 1s. 6d.

**Tighe and Davis.—Annals of** Windsor; Being a History of the Castle and Town: With some account of Eton and Places adjacent. By R. R. TIGHE, Esq.; and J. E. DAVIS, Esq., Barrister-at-Law. With numerous Illustrations. 2 vols. royal 8vo. £4. 4s.

**Tooke.—History of Prices, and** of the State of the Circulation, during the Nine Years from 1848 to 1856 inclusive. Forming Vols. V. and VI. of Tooke's *History of Prices;* and comprising a copious Index to the whole work. By THOMAS TOOKE, F.R.S. and WILLIAM NEWMARCH. 2 vols. 8vo. 52s. 6d.

**Townsend.—Modern State Trials** revised and illustrated with Essays and Notes. By W. C. TOWNSEND, Esq., M.A., Q.C. 2 vols. 8vo. 30s.

**Trollope. — Barchester Towers:** a Novel. By ANTHONY TROLLOPE. New and cheaper Edition, complete in One Volume. Crown 8vo. 5s.

**Trollope. — The Warden.** By ANTHONY TROLLOPE. Post 8vo. 10s. 6d.

**The Traveller's Library: A Collection** of original Works well adapted for *Travellers* and *Emigrants*, for *School-room Libraries*, the *Libraries of Mechanics' Institutions*, *Young Men's Libraries*, the *Libraries of Ships*, and similar purposes. The separate volumes are suited for *School Prizes*, *Presents to Young People*, and for general instruction and entertainment. The Series comprises fourteen of the most popular of Lord Macaulay's *Essays*, and his *Speeches* on Parliamentary Reform. The department of Travels contains some account of eight of the principal countries of Europe, as well as travels in four districts of Africa, in four of America, and in three of Asia. Madame Pfeiffer's *First Journey round the World* is included; and a general account of the *Australian Colonies*. In Biography and History will be found Lord Macaulay's Biographical Sketches of *Warren Hastings*, *Clive*, *Pitt*, *Walpole*, *Bacon*, and others; besides Memoirs of *Wellington*, *Turenne*, *F. Arago*, &c.; an Essay on the Life and Genius of *Thomas Fuller*, with Selections from his Writings, by Mr. Henry Rogers; and a history of the *Leipsic Campaign*, by Mr. Gleig,—which is the only separate account of this remarkable campaign. Works of Fiction did not come within the plan of the TRAVELLER'S LIBRARY; but the *Confessions of a Working Man*, by Souvestre, which is indeed a fiction founded on fact, has been included, and has been read with unusual interest by many of the working classes, for whose use it is especially recommended. Dumas's story of the *Maitre-d'Armes*, though in form a work of fiction, gives a striking picture of an episode in the history of Russia. Amongst the works on Science and Natural Philosophy, a general view of Creation is embodied in Dr. Kemp's *Natural History of Creation*; and in his *Indications of Instinct* remarkable facts in natural history are collected. Dr. Wilson has contributed a popular account of the *Electric Telegraph*. In the volumes on the *Coal-Fields*, and on the Tin and other Mining Districts of *Cornwall*, is given an account of the mineral wealth of England, the habits and manners of the miners, and the scenery of the surrounding country. It only remains to add, that among the Miscellaneous Works are a Selection of the best Writings of the Rev. Sydney Smith; Lord Carlisle's *Lectures and Addresses*; an account of *Mormonism*, by the Rev. W. J. Conybeare; an exposition of *Railway* management and mismanagement by Mr. Herbert Spencer; an account of the Origin and Practice of *Printing*, by Mr. Stark; and an account of *London*, by Mr. M'Culloch.—To be had, in *complete Sets only*, at £5. 5s. per Set, bound in cloth and lettered.

☞ *The Traveller's Library* may also be had as originally issued in 102 parts, 1s. each, forming 50 vols. 2s. 6d. each; or any separate parts or volumes.

**Sharon Turner's Sacred History** of the World, Philosophically considered, in a Series of Letters to a Son. 3 vols. post 8vo. 31s. 6d.

**Sharon Turner's History of England** during the Middle Ages; Comprising the Reigns from the Norman Conquest to the Accession of Henry VIII. 4 vols. 8vo. 50s.

**Sharon Turner's History of the** Anglo-Saxons, from the Earliest Period to the Norman Conquest. 3 vols. 36s.

**Dr. Turton's Manual of the Land** and Fresh-Water Shells of Great Britain: With Figures of each of the kinds. New Edition, with Additions by Dr. J. E. GRAY, F.R.S., &c., Keeper of the Zoological Collection in the British Museum. Crown 8vo. with 12 coloured Plates, price 15s. cloth.

**Dr. Ure's Dictionary of Arts,** Manufactures, and Mines: Containing a clear Exposition of their Principles and Practice. Fourth Edition, much enlarged. With nearly 1,600 Woodcuts. 2 vols. 8vo. 60s.

**Uwins. — Memoir of Thomas** Uwins, R.A. By Mrs. UWINS. With Letters to his Brothers during Seven Years spent in Italy; and Correspondence with the late Sir Thomas Lawrence, Sir C. L. Eastlake, A. E. Chalon, R.A., and other distinguished persons. 2 vols. post 8vo.

**Van der Hoeven's Handbook of** Zoology. Translated from the Second Dutch Edition by the Rev. WILLIAM CLARK, M.D., F.R.S., Professor of Anatomy in the University of Cambridge; with additional References by the Author. 2 vols. 8vo. with 24 Plates of Figures, price 60s. cloth; or separately, VOL. I. *Invertebrata*, 30s., and VOL. II. *Vertebrata*, 30s.

**Vehse.—Memoirs of the Court,** Aristocracy, and Diplomacy of Austria. By Dr. E. VEHSE. Translated from the German by FRANZ DEMMLER. 2 vols. post 8vo. 21s.

**Von Tempsky.—Mitla; or, Incidents** and Personal Adventures on a Journey in Mexico, Guatemala, and Salvador in the Years 1853 to 1855: With Observations on the Modes of Life in those Countries. By G. F. VON TEMPSKY. With numerous Illustrations. 8vo. 18s.

**Wade. — England's Greatness:** Its Rise and Progress in Government, Laws, Religion, and Social Life; Agriculture, Commerce, and Manufactures; Science, Literature and Arts, from the Earliest Period to the Peace of Paris. By JOHN WADE, Author of the *Cabinet Lawyer*, &c. Post 8vo. 10s. 6d.

**Wanderings in the Land of** Ham. By a DAUGHTER of JAPHET. Post 8vo. 8s. 6d.

**Waterton.—Essays on Natural** History, chiefly Ornithology. By C. WATERTON, Esq. With an Autobiography of the Author, and Views of Walton Hall. 2 vols. fcp. 8vo. 5s. each.

**Waterton's Essays on Natural** History. THIRD SERIES; with a Continuation of the Autobiography, and a Portrait of the Author. Fcp. 8vo. 6s.

**Webster and Parkes's Encyclo**pædia of Domestic Economy; comprising such subjects as are most immediately connected with Housekeeping: viz. The Construction of Domestic Edifices, with the Modes of Warming, Ventilating, and Lighting them—A description of the various Articles of Furniture, with the Nature of their Materials—Duties of Servants—&c. With nearly 1,000 Woodcuts. 8vo. 50s.

**Weld. — Vacations in Ireland.** By CHARLES RICHARD WELD, Barrister-at-Law. Post 8vo. 10s. 6d.

**Weld.—A Vacation Tour in the** United States and Canada. By C. R. WELD, Barrister. Post 8vo. 10s. 6d.

**West.—Lectures on the Diseases** of Infancy and Childhood. By CHARLES WEST, M.D., Physician to the Hospital for Sick Children; Physician-Accoucheur to, and Lecturer on Midwifery at, St. Bartholomew's Hospital. 8vo. 14s.

**Willich's Popular Tables for** ascertaining the Value of Lifehold, Leasehold, and Church Property, Renewal Fines, &c. With numerous additional Tables—Chemical, Astronomical, Trigonometrical, Common and Hyperbolic Logarithms; Constants, Squares, Cubes, Roots, Reciprocals, &c. Fourth Edition. Post 8vo. 10s.

**Wilmot's Abridgment of Black**stone's Commentaries on the Laws of England, in a series of Letters from a Father to his Daughter. 12mo. 6s. 6d.

**Wilson's Bryologia Britannica:** Containing the Mosses of Great Britain and Ireland systematically arranged and described according to the Method of *Bruch* and *Schimper*; with 61 illustrative Plates. Being a New Edition, enlarged and altered, of the *Muscologia Britannica* of Messrs. Hooker and Taylor. 8vo. 42s.; or, with the Plates coloured, price £4. 4s.

**Yonge.—A New English-Greek** Lexicon: Containing all the Greek Words used by Writers of good authority. By C. D. YONGE, B.A. *Second Edition*, revised. Post 4to. 21s.

**Yonge's New Latin Gradus:** Containing Every Word used by the Poets of good authority. For the use of Eton, Westminster, Winchester, Harrow, and Rugby Schools; King's College, London; and Marlborough College. *Fifth Edition*. Post 8vo. 9s.; or, with APPENDIX of *Epithets*, 12s.

**Yonge's School Edition of Ho**race.—Horace, with concise English Notes for Schools and Students. By the Rev. J. E. YONGE, King's College, Cambridge; Assistant Master at Eton. PART I. *Odes* and *Epodes*, 12mo. 3*s*.; PART II. *Satires* and *Epistles*, 3*s*. 6d.

**Youatt.—The Horse. By Wil**liam Youatt. With a Treatise of Draught. New Edition, with numerous Wood Engravings, from Designs by William Harvey. (Messrs. LONGMAN and Co.'s Edition should be ordered.) 8vo. 10s.

**Youatt.—The Dog. By William** Youatt. A New Edition; with numerous Engravings, from Designs by W. Harvey. 8vo. 6s.

**Young.—The Christ of History:** An Argument grounded in the Facts of His Life on Earth. By JOHN YOUNG, LL.D. Second Edition. Post 8vo. 7s. 6d.

**Young.—The Mystery; or, Evil** and God. By JOHN YOUNG, LL.D. Post 8vo. 7s. 6d.

**Zumpt's Grammar of the Latin** Language. Translated and adapted for the use of English Students by Dr. L. SCHMITZ, F.R.S.E.: With numerous Additions and Corrections by the Author and Translator. 8vo. 14s.

[*October* 1858.

PRINTED BY SPOTTISWOODE AND CO., NEW-STREET SQUARE, LONDON.

ISO
9002

ley Dunn & Wilson Ltd
PERT CONSERVATORS & BOOKBINDERS